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भाकृ अनुप
ICAR

CMFRI

वार्षिक प्रतिवेदन

Annual Report

2004-05

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ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Ernakulam North P.O., Cochin - 682 018, India

CMFRI Annual Report 2004-2005

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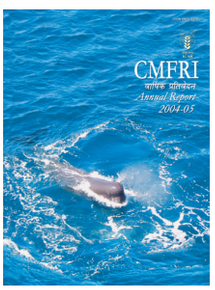
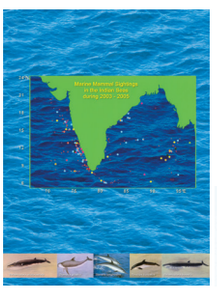


Sperm whale *Physeter macrocephalus* sighted off Badagara on board FORV *Sagar Sampada*



Marine mammal sightings in the Indian seas recorded by CMFRI during 2003-2005

Tursiops spp. *Stenella longirostris* *Sousa chinensis* *Delphinus delphis*
Globicephala macrorhynchus *Physeter macrocephalus* *Pseudorca crassidens*
Stenella coeruleoalba *Balaenoptera borealis* *Grampus griseus*
Unidentified dolphins Unidentified whales

Cover design & Layout : Dr. P. Jayasankar, Dr. E.V. Radhakrishnan, Dr. K.S. Mohamed, Dr. M. Rajagopalan and Shri. Anoop. K. Krishnan

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CONTENTS

PREFACE

Marine fisheries management decisions must target sustainability and anchor on accurate and timely data on resource dynamics including fishing effort and fishing mortality, both targeted and incidental. The major mandate of CMFRI is to monitor and assess the exploited marine fishery resources and provide analytical inputs in terms of effort, gear and mesh regulations, closure of areas and seasons, socioeconomic development and food and livelihood securities of fishing communities. To give more focused attention and thrust on the biodiversity conservation concerns and mariculture technologies, two new divisions, Marine Biodiversity Division and Mariculture Division were established during 2004.

One of the major outputs during the current year was the time series analysis of marine fish landings in the southwest coast of India for 1961-2003, which predicted decline in landings in the long run, if the present mode of exploitation is continued. The Institute also initiated the *Marine Fisheries Census 2005*, which is aimed at collection of primary data on the number of fishing villages, landing centres, fishermen population, demography, active fishermen, fishing crafts & gears, socio economic status of fishers, earnings, livelihoods, etc.

Tsunami had no apparent adverse effect on the fishery and biological characteristics of pelagic fishes. While all India catches of tuna showed decrease, Indian mackerel landings registered increase during this year. The Institute had provided mandatory data required on gear-wise catch, effort, species and size composition of coastal tunas for the year 2003 to the Indian Ocean Tuna Commission (IOTC).

Studies have indicated overexploitation of threadfin breams, flatfish and lizard fishes as well as a visible negative impact of bottom trawling on the habitat and taxonomic biodiversity of the benthic organisms in the currently exploited waters off Mangalore. The Institute achieved successful production and survival of a batch of 77 juveniles of the high value marine ornamental fish three spot damsel *Dascyllus trimaculatus* at Mandapam.

The studies carried out indicated that the low catches of deep-sea shrimps off Sakthikulangara were related to the decreased fishing effort during the post tsunami season. At Cochin, Calicut and Kakinada, the crab, *Charybdis lucifera* emerged as a new fishery resource. The Institute achieved the first time successful maturation and spawning of the rock lobster *Panulirus longipes* in captivity.

In Kerala, the yield and catch rate of cephalopods had improved during the year, presumably due to the self-restrained ban on trawling during night. The Institute achieved commendable success in the development, refinement and popularization of bivalve mariculture technologies, including designing and fabrication of a de-clumping machine and a seeder. Experimental 'Bouchot' culture of mussels, production of cultchless spat of edible oyster, tissue culture and colour improvement of marine pearls were all significant achievements. GIS mapping of mussel seed resources and culture sites in India was completed.

The monitoring program on the environmental impact of effluent discharges in coastal waters indicated high levels of pollution in Veraval, Mumbai, Cochin, Chennai and Karwar. GIS-based study identified 5 potential mariculture sites in Karnataka and Andhra Pradesh. A significant achievement was the generation of primary information on the marine mammals from the Indian EEZ based on cruise sightings, analysis of heavy metals and DNA typing.

Another achievement was the purification of phytase enzyme from *Bacillus licheniformis* and isolation of a putative probiotic bacterial strain from the healthy shrimp gut, which significantly improved disease

resistance and immunological responses in Indian white shrimp. The GenBank (NCBI) released a microsatellite DNA sequence in the domesticated clown fish *Amphiprion sebae* (AS 10, 129 bp) developed by the Institute.

The Institute's investigations on the socio-economic scenario of marine fisheries have been noteworthy. Crustaceans fetched about 40% gross revenue between first and last sale levels. Per capita investment in motorized sector showed signs of decline. It was noticed that the economic impact at 25% level of village adoption in monoculture and polyculture of finfish, diary farming, poultry and coconut plantation could result in the generation of an additional revenue to the tune of Rs. 420 crores in Kerala. Through diagnostic services, laboratory tests and sale of value added fishery products, publications and other technological inputs, the ATIC generated an income of Rs 1.18 lakhs.

Total revenue generation of the Institute stood at Rs 83.4 lakhs, as against a target of Rs 75 lakhs, winning accolades from the DG, ICAR. CMFRI was in the forefront for promoting the use of *Rajya basha*, as evidenced by winning the top slot in the purchase of Hindi books during 2004. A modern Marine Biodiversity Museum was established. Among the several papers published in peer-reviewed journals, the scientists published 9 papers in peer reviewed foreign journals and 48 in peer reviewed national journals. Thirteen new externally sponsored projects were approved for implementation. The Institute continued its human resource development through the postgraduate programs in mariculture and training.

This report presents the summary and results of the research work carried out by CMFRI during 2004-05. The staff of the Institute have strived towards fulfilling the mandates of the Institute. I am grateful to Dr. Mangala Rai, Director General of ICAR for the support extended to achieve our targets. I place on record our sincere thanks to Dr. S. Ayyappan, Deputy Director General (Fy.), Dr. A.D. Diwan, Assistant Director General (M.Fy.) and Shri. Anil Agarwal, Principal Scientist (M.Fy.) for their generous support and guidance.

Cochin
25 July 2005

MOHAN JOSEPH MODAYIL
Director

Executive Summary

Keeping in view its mission to address issues in sustainability of the marine fishery resources, the CMFRI has implemented 51 in house projects, 35 sponsored national projects, 1 sponsored international project, 6 NATP projects, and 9 consultancy projects during the period 2004-05. Two new divisions, Marine Biodiversity Division and Mariculture Division were established during 2004. The salient outputs are summarized here.

Capture fisheries

The marine fish landings of India during 2004 have been provisionally estimated at 2.6 million t, which showed a marginal decline by about 1% against the estimate of the previous year. Decline in the landings of oil sardine, Bombay duck, croakers, seerfishes, ribbonfishes, tunas, penaeid prawns, non-penaeid prawns and cephalopods have contributed to this decrease. Landings of perches and Indian mackerel had improved. West coast contributed to about 65% of total marine landings. Mechanized landings were to the tune of 68%, while motorized and artisanal sectors contributed 25% and 7%, respectively. Projection based on 'Markov chain model' indicated that there would be decline in the marine fish landings along south west coast, if the present mode of exploitation were continued.

Oil sardine registered a decline to the tune of about 23,000 t compared to the previous year. The graphic model developed based on rainfall and oil sardine catch over 50 years would be useful to forecast the fishery. Large-scale entry of oil sardine (60-105 mm) into the backwaters during October-December was noteworthy. Truss morphometric analysis showed perceptible shape variations in these "dwarf/stunted" individuals from the "normal" ones. No visible impact on the fishery and biological characteristics of sardines was noticed after the tsunami.

The traditional dol net fishery for anchovies at many dol net centers in Maharashtra has become a losing proposition while trawlers have increasingly exploited the resource.

Exploitation ratio (E) of seerfishes along both west and east coasts has been high. Some of the management options available include, restriction in the operation of small meshed *podivalai* along southeast coast, which catch young fishes and encouraging the use of hooks and lines, large meshed gill nets as well as extending their operational range to deeper waters.

Total tuna landings from the mainland registered 13% decline during this year compared to 2003, while those of Minicoy have increased. Production of *Euthynus affinis* stabilized at around 17,000 t and the species was optimally exploited. Indian mackerel landings, estimated at 1.43 t, have shown 26% increase this year. No direct impact of tsunami on mackerel fishery was noted in any of the centres except Chennai where fishing was suspended during January-February.

Ribbonfish fishery declined to the tune of about 17,000 t this year and in all the centers except Veraval, this resource was over exploited, calling for a reduction in the fishing effort, particularly in the east coast.

Elasmobranchs contributed to 9.1% of total demersal fish landings, with sharks, rays and skates forming 61%, 33% and 6%, respectively. Rare landings of the oceanic shark *Alopias vulpinus* at 100 m depth off Malabar coast were reported. A rare species of snaggletooth shark (*Hemipristis elongates*) was recorded at Calicut. While grouper landings registered an increase of 8%, catfish catches reduced marginally to the tune of about 400 t.

Landings of threadfin breams and silverbellies improved by 18% and 8% over 2003. *Nemipterus japonicus* off Malabar coast was overexploited. Truss morphometric analysis of *N. japonicus* from east and west coasts indicated that the populations/stocks of the species were different. The all India landings of croakers, 1.21 lakh t, have remained at the same level of exploitation as that of last year. Population parameters estimated for the lizardfishes at various centres pointed out the possibility of their overexploitation. Heavy exploitation of flatfish, *Cynoglossus macrostomus* from Calicut (E ratio, 0.79) was evident.

Studies on bottom trawling off Mangalore coast clearly pointed to its negative impact on the habitat biodiversity and taxonomic biodiversity of the benthic organisms in the waters of depth between 10 and 50 m.

Crustacean landings showed decline during 2004 constituting 14.2% of total marine annual landings. Penaeid (47.8%) and non-penaeid shrimps (31.7%) were the dominant groups. Stocks of *Parapenaeopsis stylifera, Metapenaeopsis stridulans, M. kutchensis, Metapenaeus brevicornis* and *Penaeus merguiensis* are heavily exploited from the Saurashtra region. Stock assessment studies on *Fenneropenaeus indicus* off Calicut showed that the present fishing effort could be increased by 1.6 times to reach the MSY. Deep sea shrimp catch (2113 t) improved considerably over the year 2003. The decline in non-penaenid landings in the Dol net fishery during 2004 was due mainly to the poor catches of *Acetes*. There was a marginal increase to the tune of about 193 t in lobster landings compared to the previous year. High exploitation ratio of *Panulirus polyphagus* off Mumbai warrants immediate management measures. The crab, *Charybdis lucifera* has emerged as a new fishery resource at Cochin, Calicut and Kakinada.

The all India production of cephalopods estimated at 1.13 lakh t, showed a decline by 4%. However, in Kerala, the total production and catch rate had improved, presumably due to the self-restrained ban on trawling during night. The steady increase in Z value of *Sepia pharaonis* since 2002 signals need for greater caution. The all India bivalve production showed an increase of 28% during 2004. After tsunami, there was increase in the landings of Palk Bay squid *S. lessoniana* and semi fossilized sacred chank *Xancus pyrum*.

Mariculture

Successful production and survival of a batch of 77 juveniles of the three spot damsel *Dascyllus trimaculatus* could be achieved at Mandapam. About 2.4 million PL of *Penaeus semisulcatus* were sea ranched in the Gulf of Mannar during 2004. For the first time, successful maturation and spawning of *Panulirus longipes* was achieved in captivity. Feed and feeding schedules for the larval rearing of the slipper lobster *Thenus orientalis* has been standardized. Unilateral eye stalk ablation of mature female spiny lobsters resulted in reduced growth rate and increased reproductive activity, combined with more frequent spawning. Under an MPEDA-sponsored project, a preliminary campaign on lobster conservation and protection of egg bearing lobsters was completed in Tamil Nadu.

The Institute has developed a manually operated mussel de-clumping machine. The mussel seeder is being popularized among the farmers of Kasargod and Calicut. Experimental 'Bouchot' culture of mussel gave a production of 12 kg/m within three months. Technology for producing cultchless spat of edible oyster was developed. In the tissue culture experiments on marine pearls, *in-vitro* nacre coating process was found to continue for several months. Colour improvement of marine pearls was achieved through metal enrichment. Metal enrichment did not affect the lusture of the pearl. Under NATP, GIS mapping of mussel seed resources and culture sites in India was completed. Culture and broodstock development of blacklip oyster *Pinctada margaritifera* was initiated in the Andamans and Nicobar islands.

Experimental farming of carrageenan yielding red seaweed *Kappaphycus alvarezii* was carried out. At Cochin, the species showed a growth rate of 16g/day within 40 days of culture period. At Mandapam, there was 4-5 fold increase in 22-34 days, while at Calicut, 4-fold increase in 60 days.

Environmental & Biodiversity studies

The Institute had carried out detailed study of blooming of toxic/harmful phytoplankton along the Kerala coast during August-September and a public awareness campaign on the safe consumption of fish from affected areas was conducted. The study on the environmental impact of effluent discharge in coastal waters showed that concentrations of metals, such as cadmium, lead, copper and nickel in seawater, sediment and biota collected from the industrialized areas of Veraval, Mumbai, Cochin, Chennai and Karwar were high compared to the samples collected from relatively cleaner areas. GIS based study has identified 3 potential mariculture sites from Karnataka and two from Andhra Pradesh. A taxonomic monograph on the planktonic shrimps of the family Luciferidae was prepared based on the collections on board *FORV Sagar Sampada* from the Indian EEZ.

Under a DOD-sponsored project, 146 marine mammals were sighted from 10 cruises on board *FORV Sagar Sampada* from the Arabian Sea and Bay of Bengal. Pollution studies based on 23 elements from various tissues

of cetaceans showed variation in different matrices of the same animal. Mitochondrial DNA typing of *Tursiops* spp, *Stenella longirostris, Grampus griseus, Delphinus delphis* and *Physeter macrocephalus* yielded primer-specific bands, which would be sequenced for molecular taxonomy purpose.

Biotechnology

The phytase producing *Bacillus* strain isolated from mangrove swamp has been identified by IMTECH and designated as IJ – *Bacillus licheniformis* – MTCC 6824. Process for purification of phytase enzyme from fermented product using the *Bacillus* has been standardized.

Twenty-three solvent fractions of the purified extract from the marine plant, *Ulva fasciata* exhibited moderate to high antibiotic activity against several bacterial pathogens. A putative probiotic bacterial strain G23 (*Bacillus* sp.) isolated from healthy shrimp gut, resulted in significant improvement in disease resistance and immunological responses in the shrimp *Fenneropenaeus indicus.*

Genetic fingerpring of oil sardine and *Nemipterus japonicus* from 5 locations indicated that their respective populations/stocks are genetically different between the east and west coasts. Phylogenetic relationship in four species of marine ornamental fish, *Abudefduf* was established. A microsatellite DNA sequence developed in the domesticated clown fish species *Amphiprion sebae* (AS 10, 129 bp size) was released by the GenBank (NCBI) with the accession number DQ079821.

Extension & Economics

Price structure economic evaluation of marine landings has shown that in crustaceans alone there was 40% gross revenue between first and last sale levels. Gross capital investment on fishing craft and gear has significantly increased, particularly in mechanized trawlers and gill-netters. It was interesting to note that the per capita investment of motorized sector declined, which in economic sense is a welcome trend. Under IVLP, six techno interventions were selected for horizontal expansion in Kerala and worked out the projected economic impact at 25% level adoption of culture of monoculture of grey mullet and milkfish, polyculture of finfish, diary farming, poultry and coconut plantation.

The ATIC had generated an income of 1.18 lakh rupees during 2004 through diagnostic services, laboratory tests and sale of value added fishery products, publications and other technological inputs. Three pamphlets on ‘Marine pollution’, ‘Seaweed Recipes’ and ‘Marine Ornamental Fishes’ in English and Hindi versions were released.

Publications, New projects & Recognitions

Staff of the institute had published a total of 48 research papers in peer-reviewed journals, of which 9 are in foreign journals, 71 technical articles and 23 papers in seminars/symposia. The Institute has won the Merit Certificate from Kochi TOLIC for topping among the Institutes in the purchase of Hindi books and coordinating the orders on purchase. Various programmes for competency development in Hindi were organized during 2004. Thirteen new projects on issues related to tsunami, fishery resource assessment, salt tolerance genes, shrimp broodstock development, immunodiagnostics, nutrition etc. were approved under ICAR Ad hoc scheme and DOD funding for implementation.

Training & Education

Under the education programme, 11 regular students and scholars of sponsored projects of the institute were awarded Ph. D. degrees during 2004. KVK conducted 40 training programmes and 106 courses during the reporting year.

Revenue generation

Against a target of Rs. 75 lakhs, the Institute generated revenue Rs. 83.4 lakhs and received a letter of appreciation from the Director General, ICAR.

INTRODUCTION

India is endowed with a long coastline of 8,129 km, 0.5 million sq km of continental shelf, 2.02 million sq km of EEZ and an estimated annual Marine Fishery Resource Potential of 3.9 million t. The vast areas along the coastline offer ideal sites for seafarming and coastal mariculture. The Indian marine fisheries sector plays a significant role in supplying protein-rich food to the increasing population, employment generation and foreign exchange earning. The present marine fisheries scenario in India is characterised by declining yields from the inshore waters, increasing conflicts between different resource users, increasing demand for sea-food for domestic consumption and export and prospects for large scale seafarming and coastal mariculture. This warrants greater and more effective R&D efforts to enable implement suitable action plans for sustained marine fisheries and mariculture development.

The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of 57 years since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R&D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established marine fisheries laboratory in the world.

To accomplish its mandate, the Institute monitors the landings on a continual basis from all along the country's coast, conducts researches on characteristics of exploited marine fish stocks; carries out exploratory surveys and assesses the under - and unexploited resources, develops seafarming techniques, undertakes research in fishery environmental characteristics and sea-dynamics, studies on biodiversity and conducts postgraduate education programmes leading to M.F.Sc. and Ph.D. degrees. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set-up

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research Centres at Minicoy, Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin, Chennai and Kakinada and 15 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities for carrying out research programmes and has been upgrading the same to meet the changing needs and additional requirements. The sanctioned

The Mandate

To monitor the exploited and assess the under-exploited marine fisheries resources of the Exclusive Economic Zone .

To understand the fluctuations in abundance of marine fisheries resources in relation to change in the environment.

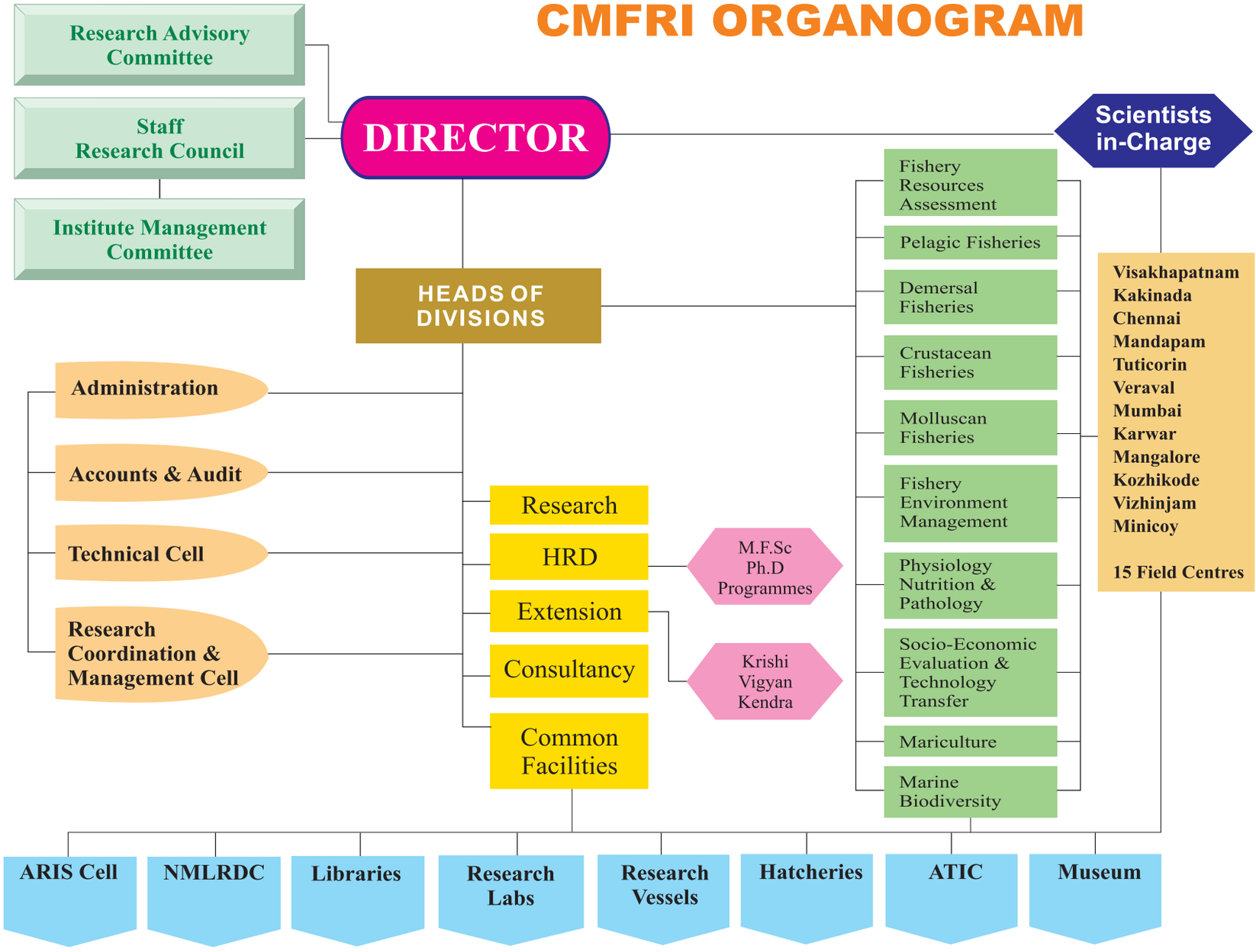
To develop suitable mariculture technologies for finfish, shellfish and other culturable organisms in open seas to supplement capture fishery production.

To act as a repository of information on marine fishery resources with a systematic database.

To conduct transfer of technology, post graduate and specialized training, education and extension education programmes.

To provide consultancy services.

CMFRI ORGANOGRAM



Budget 2004 – 2005

(Rs. in lakhs)

(Rs. in lakhs)

Sl. No.	Sub Head	RE	Progressive Expenditure upto March 2005
NON PLAN			
1	Estt. charges	1412.00	1412.00
2	O.T.A.	1.20	1.20
3	T.A	18.60	18.60
4	Other Charges	474.70	420.63
	(Enhancement of Imprest)		0.20
5	Works	41.00	94.87
6	Other Items	3.50	3.50
	TOTAL	**1951.00**	**1951.00**
PLAN			
1.	Estt. Charges	-	-
2	T.A.	21.00	21.00
3	(a) Other Charges including Equip.	310.00	310.21
	(b) Information Technology	20.00	19.79
4	Works		
	1. Works as per EFC		
	(a) Special Repairs	52.00	52.00
	(b) Major works		
	2. One time Catch-up-grant		
5.	Other Items		
	HRD	1.00	1.00
	Total 1 to 5	**404.00**	**404.00**

staff strength of the Institute is: Scientific 186, Technical 338, Administrative 150, Auxiliary 6 and Supporting 279.

The multidisciplinary researches in capture and culture fisheries are conducted under ten Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology, Socio-economic Evaluation and Technology Transfer, Mariculture and Marine Biodiversity. Interdivisional and interinstitutional programmes are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas through *ad hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D programmes of the Central Institute of Fisheries Education, Mumbai, a Deemed University under the ICAR. The teaching programme is carried out by the scientists of the Institute.

The *Krishi Vigyan Kendra* imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country.

The results of research carried out in the Institute are published in various journals. Besides, the Institute brings out Bulletins, Special Publications and the Marine Fisheries Information Service and publishes the Indian Journal of Fisheries.

Staff position at CMFRI as on 30.07.2005

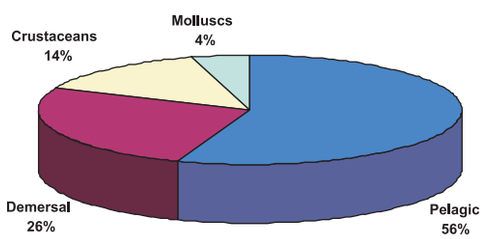
Category	Sanctioned	Filled in	Vacant
Research & Management Position	1	1	0
Scientific	186	120	66
Technical	338	324	14
Administrative	150	140	10
Supporting	279	239	40
Auxiliary	6	6	0
Total	960	830	130

FISHERY RESOURCES ASSESSMENT DIVISION

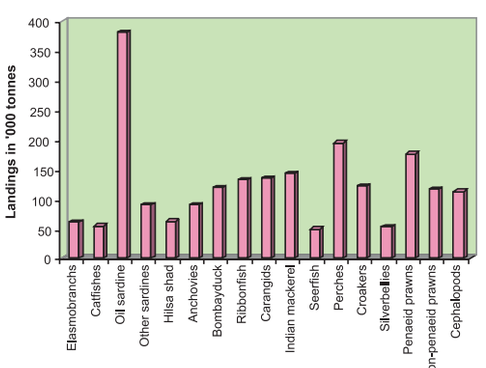
During this year the research was carried out under four research projects. Apart from handling of these projects, the Scientists of the Division were also associated with several inter-divisional projects of the Institute. The Scientists of the Division were actively involved in teaching bio-statistics, computer applications, fish population dynamics and fisheries management under the Post Graduate Programme in Mariculture. The expertise of the scientists was also utilized by many scientists of the Institute in designing experiments and analyses of the data and in fish stock assessment studies.

PROJECT CODE	**FRA/ASSESS/01**
PROJECT TITLE	**Assessment of Exploited Marine Fishery Resources**
SCIENTISTS	**K. Balan,** M. Srinath, T.V. Sathianandan, J.Jayasankar, Wilson T. Mathew, Somy Kuriakose and Mini, K.G
CENTRES	Cochin and Chennai

- *The marine fish landings of India during the year 2004 has been provisionally estimated at 2.6 million tonnes which recorded a decrease of 24,000 t against the estimate of the previous year.*
- *The pelagic finfishes constituted 54%, demersal fishes 27%, crustaceans 14% and molluscs 5% of the total landings.*
- *The mechanized landings during the year 2004 was 68%, motorized 25% and the rest 7% artisanal.*



Components of marine fish landings in India, 2004

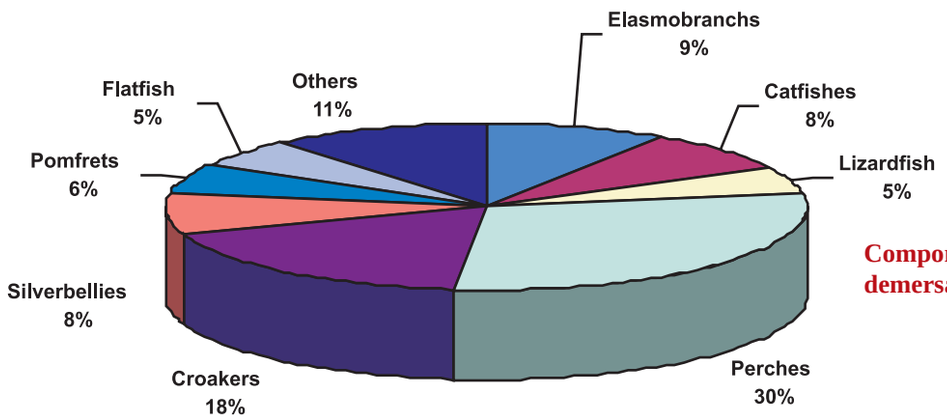


Landings of major fishery resources during 2004

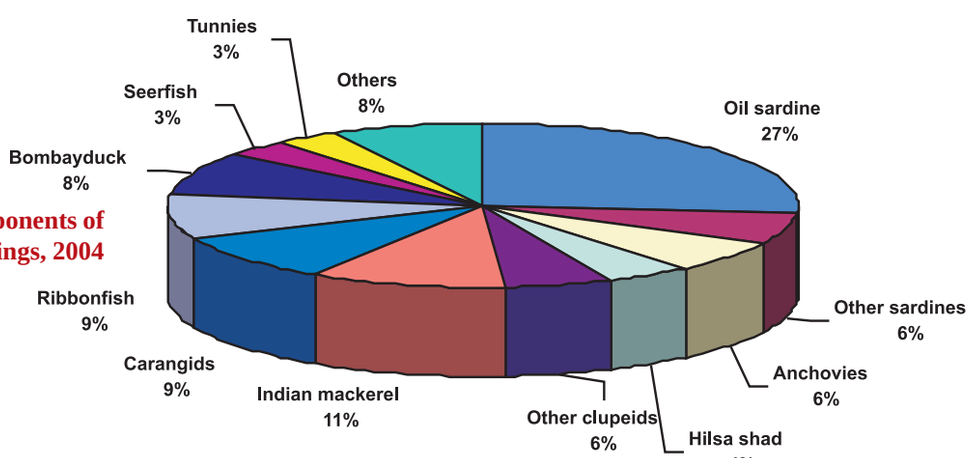
The project aims to arrive at the estimate of marine fish landings and fishing effort in different regions of the country with resource-wise and gear-wise break up of the exploited resources. It also envisages to maintain and update the database on the Marine Information System existing at the Institute.

A multistage stratified random sampling design was employed to collect and estimate the landings of the exploited marine fishery resources. It involved planning, execution and co-ordination of field work, processing of data and updating database, developing suitable formats for storage and retrieval.

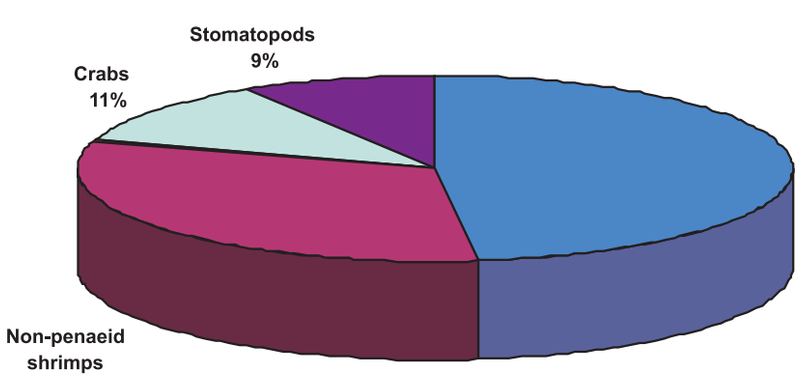
- Among the commercially important groups, fishery of oil sardine, Bombayduck, croakers, seerfishes, penaeid prawns and cephalopods recorded decrease in the catches and there is a slight increase in lesser sardines. The fishery of ribbonfishes, and non-penaeid prawns recorded lesser landings.
- Perches and Indian Mackerel landings had improved.
- The estimate of region-wise production showed that the north east region, comprising West Bengal and Orissa coasts contributed 10.6% to the total production. South east region consisting of Andhra Pradesh, Tamilnadu and Pondicherry coasts contributed 24.0%. On the west coast, southwest region comprising Kerala, Karnataka and Goa coasts recorded 34.8% of the total, whereas, the northwest region comprising Maharashtra and Gujarat coasts contributed a maximum of 30.6 %.
- Oil sardine landings recorded 3.81 lakhs during the year registering 5% decline over the previous year.
- The Bombayduck fishery showed a decrease of about 11,000 t (8%) with an estimate of 1.2 lakh during 2004.
- The fishery of croakers was 1.22 lakh t with a marginal decrease of 1,000 t over the previous year.
- A decrease of 39,000 t was observed in the landings of penaeid prawns, the estimate being 1.8 lakh t during 2004.
- Cephalopods fishery also declined marginally during 2004 with a



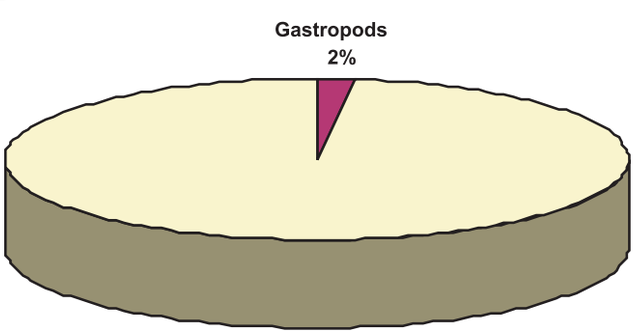
Components of demersal finfish landings, 2004



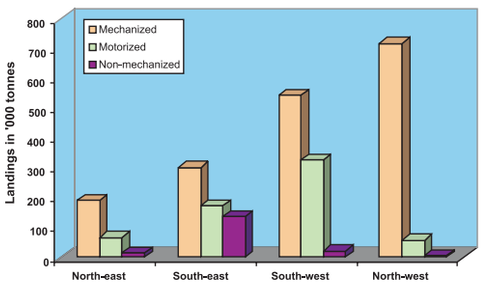
Components of pelagic finfish landings, 2004



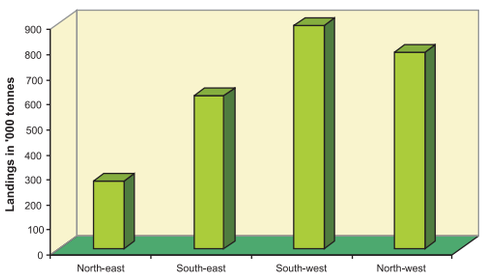
Components of crustacean landings, 2004



Components of molluscan landings, 2004



Sector-wise landings in different regions, 2004



Region-wise landings in India, 2004

decrease of 4500 t with an estimate of 1.13 lakh t.

- The landings of perches recorded an increase of 17,000 t (10%), with an estimate of 1.95 lakh t.
- The landings of mackerel also recorded an increase of 30,000 t with an estimate of 1.43 lakh t.
- The estimate of ribbonfishes was 1.32 lakh t which recorded a decline of 16,000 t.
- The landings of carangids was 1.35 lakh t with an increase of about 6,000 t.
- The non-penaeid fishery also witnessed a decline of about 21,000 t with an estimate of 1.16 lakh t.
- The database on landings of exploited marine fishery resources maintained by the Institute has been updated with current estimates of 2004.

PROJECT CODE **FRA/ASSESS/02**

PROJECT TITLE **Stock Assessment Techniques in Marine fish and Shellfish Resources and Management**

SCIENTISTS **M. Srinath,** T.V. Sathianandan, J. Jayasankar, Wilson T. Mathew and Somy Kuriakose

CENTRES Cochin and Chennai

The project aims to review the existing methodology in stock assessment, develop methods suitable to the tropical multi-species and multi-gear systems and development of software for fish stock assessment.

- The annual mean trophic level (TrL) of marine fish landings along the Indian coast consisting of 53 exploited species/groups was estimated for the period 1950-2002.
- The landings as well as TrL increased along the northwest (NW) and southwest (SW) coasts.
- However, increase in the landings was associated with decrease in mean TrL along the east coast, particularly along the southeast (SE) coast at the rate of 0.04 per decade.
- The increasing trend of the Fishery in Balance (FIB) index ceased in the last 5 to 10 years along these three coasts. A backward-bending signature in the landings *vs* TrL plot for the SE coast in the last six years indicates fisheries-induced changes in the ecosystem owing to low productivity of the coastal waters and high density of fishing craft.
- The landings of most of the large predators increased along the Indian coast, but higher removals appear to have helped proliferation of their prey, the midlevel carnivores.
- Fishing the food web has been influenced by environmental fluctuations, advanced fishing technologies, and market driven,

deliberate fishing on low- trophic level (TrL) invertebrates such as the penaeid prawns.

PROJECT CODE	**FRA/MOD/03**
PROJECT TITLE	**Application of Simulation Models for Fisheries Management Game**
SCIENTISTS	**T.V. Sathianandan,** M. Srinath, Sunilkumar Mohamed, J.Jayasankar, Somy Kuriakose and Mini, K.G
CENTRES	Cochin and Chennai

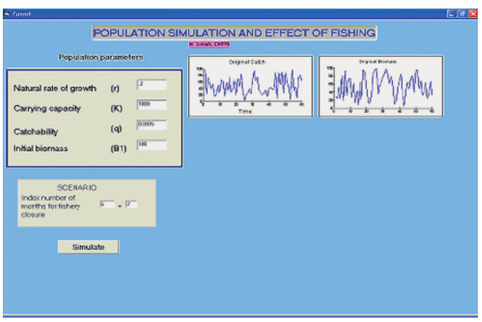
The project aims at developing simulation models, validate the developed model using available information about the resources and use the validated simulation model to quantitatively estimate the effects of management options on the fishery resources in the form of a management game.

- Developed a macro level simulation model based on surplus production model. Effect of closure of fishery is simulated using a biomass dynamic model incorporating process and observation uncertainty. The programme SIMSRI1 was developed in VB.

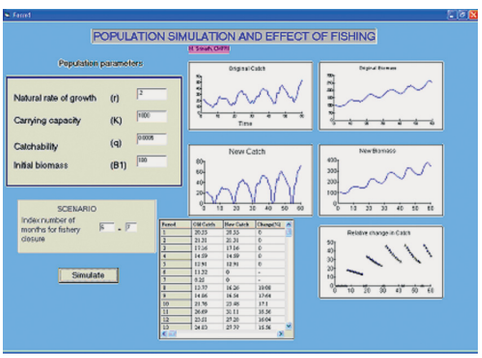
Initial screen will be as follows and parametric inputs and months of closure can be input in the respective boxes.

- Included the multi-gear component into the developed simulation model for the fishery of oil sardine (*Sardinella longiceps*) in Kerala taking into account the biological and other fishery related factors.
- Derived an expression for computing the probability distribution of catch of a species by different gears based on Baye's theorem.
- Two objects in C++ language were developed which form part of the necessary software for carrying out the simulation experiments. This include methods to generate Uniform random number between 0 and 1, Standard normal variate, Bivariate normal variates, Binomial random variate, Poisson random variate and for computing basic statistics.
- Seasonal variation in the catch of oil sardine at different growth stages were worked out for use in the simulation study.
- Computed average length of *Sardinella longiceps* for different growth stages using data available in *biobase* of *NMLRDC* .

Screen shot-1



Following screen is the output generated from the previous step.



Different scenarios can be built with varying parametric inputs and periods of closure of fishery.

Estimated Marine Fish Landings (t) during 2003 and 2004

Pelagic finfish			Demersal finfish		
Name of fish	**2003**	**2004**	**Name of fish**	**2003**	**2004**
CLUPEOIDS			ELASMOBRANCHS		
Wolf herring	14879	14318	Sharks	30160	37423
Oil sardine	403952	381448	Skates	2633	3468
Other sardines	102394	90257	Rays	25126	20093
Hilsa shad	37897	62925	EELS	10232	7878
Other shads	6273	5973	CATFISHES	54059	53712
Coilia sp.	37949	35718	LIZARD FISHES	29863	35911
Setipinna sp.	5371	5055	PERCHES		
Stolephorus spp.	41909	49155	Rock cods	16890	18213
Thryssa sp.	27894	26440	Snappers	6000	6974
Other clupeids	38068	36712	Pig face breams	10547	11274
BOMBAYDUCK	130391	119320	Threadfin breams	104925	118899
HALF BEAKS &			Other perches	39813	40066
FULL BEAKS	5649	3794			
FLYING FISHES	4881	2598	GOATFISHES	12482	16318
RIBBON FISHES	148471	132005	THREADFINS	10023	9825
CARANGIDS			CROAKERS	122650	121597
Horse Mackerel	30927	25718	SILVERBELLIES	48544	52827
Scads	28493	41693	WHITEFISH	3122	3280
Leather-jackets	10545	11526	POMFRETS		
Other carangids	59093	55926	Black pomfret	15699	17545
MACKERELS			Silver pomfret	21775	20098
Indian mackerel	113439	143333	Chinese pomfret	1988	2024
Other mackerels	5	0	FLAT FISHES		
SEER FISHES			Halibut	1167	1047
S. commersoni	34141	33165	Flounders	50	122
S. guttatus	15410	15016	Soles	44592	35033
S. lineolatus	0	3	Miscellaneous	24824	36363
Acanthocybium spp.	24	196			
TUNNIES			**Total**	**637164**	**669990**
E. affinis	18841	20573			
Auxis spp	12397	7772	**Shellfish**		
K. pelamis	2212	3387	CRUSTACEANS		
T. tonggol	3567	7016	Penaeid prawns	215049	175662
Other tunnies	15337	6936	Non-penaeid prawns	137229	116231
BILL FISHES	4631	7025	Lobsters	1245	1438
BARRACUDAS	14997	14555	Crabs	42117	41033
MULLETS	5010	6637	Stomatopods	37341	32071
UNICORN COD	900	808	MOLLUSCS		
Miscellaneous	55781	78450	Cephalopods	117292	112774
			Miscellaneous	1734	2084
Total	**1431728**	**1445453**	**Total**	**552007**	**481293**
			Grand total	**2620899**	**2596736**

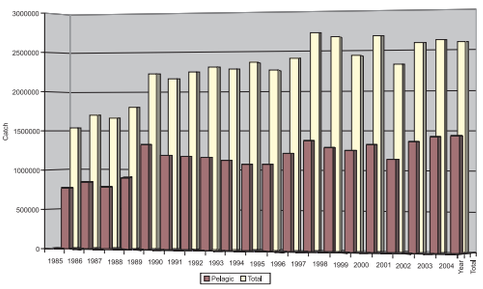
PELAGIC FISHERIES DIVISION

During 2004-05 the Pelagic Fisheries Division implemented eight in-house projects on economically important pelagic finfish resources such as sardines, anchovies, mackerel, seerfishes, tunas and billfishes, ribbonfishes, Bombay duck and carangids and one project on pelagic finfish taxonomy. Three externally funded projects (two NATP and one ICAR-WorldFish Center) were completed during the year. The Division also has associated with two new projects funded by DOD and one ICAR National Network Project. The division continued to build up an application-oriented database on catch, effort, species-wise catch and size composition and other biological parameters of all commercially important pelagic finfishes. Based on this database, stock assessments of major pelagics were made. A policy paper on purse seine fishery of Karnataka was prepared.

Pelagic finfish production during 1985-2004 fluctuated from 0.78 t in 1985 to 1.4 t in 2002 forming 53% of the total marine fish production. Mechanised sector contributed about 47% to the total pelagics followed by motorized (37%) and non-motorized (16%). 64% of the production of pelagics in 2004 was obtained from the west coast and 36% from the east coast. The contributions of major pelagic finfish groups in the total landings were oil sardine (14.7%), carangids (5.2%), ribbonfish (5.1%), mackerel (5.5%), Bombayduck (4.6%), lesser sardine (3.5%), whitebait (2%), seerfish (1.9%) and tunas (1.8%) of the total production. The Indian mackerel showed signs of recovery from the progressive decline in catches experienced since 2001 when landings were at 88,288 t. Compared to the annual average decadal landings of 1.9 lakh t, the catches in 2004 were 1.43 lakh t.

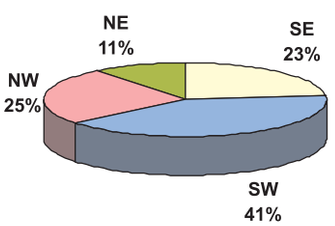
Provided mandatory data required on gear-wise catch, effort, species and size composition of coastal tunas for the year 2003 to the Indian Ocean Tuna Commission (IOTC), Seychelles for maintaining database of tunas of Indo-Pacific Region. Consolidated the reports on Impact of *Tsunami* on fisheries sector received from various Regional/Research Centres and submitted a comprehensive report to the Council.

Studies on the impact of *Tsunami* on pelagic resources indicate that there is no significant change in pattern/availability of various pelagic finfishes during the post *Tsunami* period.



Pelagic fish and total marine fish landings during 1985-2004

Ring seine- a mass harvesting destructive gear for coastal pelagics being operated from in-board engine fitted on "traditional craft" along the coast of Kerala

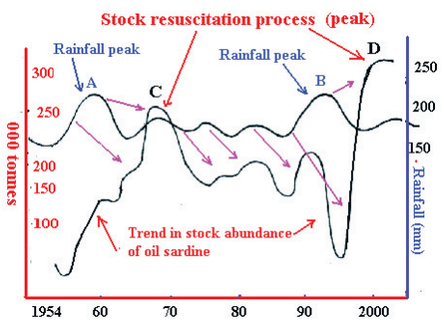


Region wise pelagic finfish landings, 2004

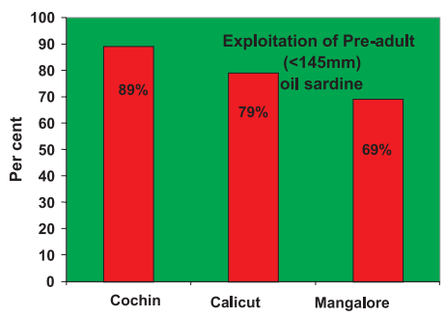
PROJECT CODE	**PEL/CAP/1**
PROJECT TITLE	**Development of Management Strategies for Sustainable Fishery of Sardines (*Sardinella* spp.)**
SCIENTISTS	**A.A. Jayaprakash,** Prathibha Rohit, M. Sivadas, E.M. Abdussamad, H. Mohamad Kasim and A.K.V. Nasser
CENTRES	Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam

- The production of 3.81 lakh t of oil sardine during the current year showed a decrease by 5.6% over last year (east coast 16%, west 84%). Production of lesser sardine was 90,000 t (east 64% and west 36%). Off Cochin and Calicut, the shoals of oil sardine mostly remained in the inshore areas, compared to Karnataka. At Cochin, ring seine catch

Fishery forecast: A graphic model developed has proved to be successful in explaining the fluctuations in abundance of oil sardine. Time series data on rainfall and oil sardine landings were considered for this. The model has proved to be useful in forecast of the fishery & trend in the availability of rainfall.



Graphic model to explain abundance of oil sardine



of 2237 t was higher by 780t. At Calicut, the ring seines contributed 98% (6392t) of the total sardine catch. At Mangalore-Malpe out of 11,535 t the purse seine contributed to 90%.

- At centres like Chennai, the exploitation of 7140t by *Kavalavalai* and 6563t by *Edavalai* appeared to be beyond MSY level.
- The pre-adults (<145mm) formed 89% at Cochin, 79% at Calicut and 69% at Mangalore, showing a decrease in their abundance towards north.
- Migration to estuaries and backwaters: Oil sardine (60-105mm) has been found to enter the Cochin backwaters, by December. This has been observed during last year also. They were caught in the Chinese nets at the entrance of the bar mouth and further upstream by various nets.
- Large-scale abundance of the recruits led to retardation in growth, low fat deposition, taste difference and reduction in fecundity. Fecundity came down to 10,000-15,000 against 38,000 during normal times and 45,000 observed during the stock resuscitation process in 1998.
- Spawning population was totally absent off Mangalore, Calicut and Cochin. The reduction in fecundity, coupled with the below normal rainfall prevailing consecutively for the last 4-5 years would lead to decrease in stock abundance in the next few years.
- The stock of oil sardine and lesser sardines remained under-exploited due to continued availability and low consumer demand, except at places like Calicut & Mangalore where a lucrative dryfish trade flourished to meet the demands of fish meal plants in Tamil Nadu and Andhra Pradesh.
- No visible impact on the fishery and biological characteristics of sardines was noticed after the tsunami.

PROJECT CODE **PEL/CAP/2**
PROJECT TITLE **Development of Management Strategies for Judicious Harvesting of Anchovies**
SCIENTISTS **Mohammad Zafar Khan,** Prathibha Rohit, A.A. Jayaprakash and H. Mohamad Kasim
CENTRES Mumbai, Mangalore, Cochin and Chennai

- The white baits fishery increased from 42, 000 (2003) to 49, 000 t (2004) but the golden anchovy production declined from 38, 000 to 36, 000 t.
- The major gears employed were trawl, purse seine, ring seine and *dol* net.
- CPUE of *C. dusumieri* was 151 and 31 kg in trawl and *dol* net respectively.
- Most of the females were with resting or developing gonadal condition. Few gravid specimens were recorded in February.
- *C. dusumieri* continues to be increasingly exploited by the trawl sector and the artisanal *dol* net fishery has become a losing proposition at many traditional *dol* net centres.

- At Mangalore-Malpe the species composition of the white baits catch was *E. devisi*, 64.1%; *S. waitei*, 14.4%; *E. punctifer*, 20.1%; *S. indicus* and others, 1.3 %.
- The size range of *E. devisi* was 42-104mm, *S. waitei* was 40-110 mm and *E. punctifer* was 58-92 mm in trawl gear.
- At Cochin the species composition of the catch was *E. devisi*, 50 %, *S. waitei*, 42 % (in trawl); and *E. devisi*, 41 % and *S. commersoni*, 27% (in ringseine).
- Most of the species spawn throughout the year with peak during monssoon period.

Research Highlights

- The estimated total mortality coefficient (Z) is 7.1 while the fishing mortality coefficient for the year is 4.83. The exploitation rate (E) is about 0.68 indicating the stock being optimally exploited.
- The estimated population parmeters for *E. devisi* are L_{∞} = 102mm, K =1.9 (annual), Z=6.66, F=3.26 and E =0.45. Status: underexploited.
- The estimated population parameters for *S. waitei* are L_{∞} = 108mm, K =1.6 (annual), Z=4.74, F=1.46 and E =0.31. Status: underexploited.

PROJECT CODE PEL/CAP/3
PROJECT TITLE **Development of Strategies for Rational Exploitation of Seerfishes**
SCIENTISTS **C. Muthiah,** N.G.K. Pillai, E.M. Abdussamad, H. Mohamad Kasim and A.K.V. Nasser
CENTRES Veraval, Mangalore, Cochin, Tuticorin, Chennai and Visakhapatnam

- The estimated seerfish landings during 2004, from the six centres along the west and east coasts of India were: 369 t at Veraval; 1,537 t at Mangalore-Malpe; 93 t at Cochin; 846 t at Tuticorin; 184 t at Chennai and 318 t at Visakhapatnam. Compared to last year, the landings declined at four centres – Veraval (20%), Cochin (45%), Chennai (43%) and Visakhapatnam (34%) while it increased at Mangalore-Malpe (1%) and Tuticorin (12%).
- Gillnet, trawl and the hook and line were the major gears contributing 35.3%, 48.5%, 9.5% respectively. Trawl has been emerging as the dominant gear along mid-west coast and northeast coast of India.
- The fishery at the six centres was constituted by four species viz., the king seer *Scomberomorus commerson*, the spotted seer *S. guttatus*, the streaked seer *S. lineolatus* and the wahoo, *Acanthocybium solandri*. Of these, the king seer and spotted seer were dominant species forming 78% and 21%, respectively. The other two species together formed less than 1%. While the wahoo was recorded only from Cochin, Tuticorin, and Chennai, the streaked seer was obtained only from Tuticorin waters.
- Overall, the length of king seer ranged from 6 to 150 cm. The mean size was 68 cm in large mesh size gillnet along the west coast and 74 cm along east coast. In hooks and lines the mean size was larger at 83 cm. In trawl the mean size was 35 cm along west coast and 36 cm along east coast. In the small mesh size gillnet, *podivalai* at Tuticorin the mean size was much lower at 27 cm.
- There was no youngfish (<34 cm) exploitation in hook and line and it was negligible in large meshed gillnet. But they were caught abundantly by trawl, forming about 60% at Mangalore-Malpe, 67%

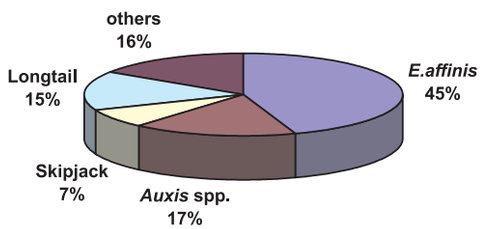
Management options

- Youngfishes of king seer are exploited heavily by trawl along the Mangalore-Malpe, Tuticorin and Chennai coasts. Hence the minimum size at first capture must be enhanced by increasing the mesh size.
- Since the small mesh gillnet like *podivalai* along the Tuticorin coast targets youngfishes, its operation should be discouraged.
- As the hooks and lines and large meshed gillnets target larger sized seerfishes, these gears may be encouraged for sustainable harvest in the inshore fishing grounds and their operational fishing areas may be extended to deeper waters by multiday fishing.

at Cochin, 70% at Tuticorin and 83% at Chennai. The small meshed gillnet *podivalai* at Tuticorin targeted youngfish abundantly (87%).

- The length range for spotted seer was 20-60 cm. The mean length was 42 cm in drift gillnet, 34 cm in trawl and 39 cm in hook and line. There was no youngfish exploitation of spotted seer by any of the gears.
- Exploitation ratio (E) was found to be higher (0.70 for king seer and 0.77 for spotted seer) for both the species along both west and east coasts of India, indicating that these species were overexploited.

PROJECT CODE	**PEL/CAP/4**
PROJECT TITLE	**Development of Strategies for Sustainable Exploitation of Tunas, Tuna live-baits and Billfishes**
SCIENTISTS	**N.G.K. Pillai,** C. Muthiah, E.M. Abdussamad,H. Mohamad Kasim and K.P. Said Koya
CENTRES	Veraval, Mangalore, Cochin, Tuticorin, Chennai and Minicoy



Species representation of total tuna landings

A bumber catch of yellowfin tuna

Handling of frozen tunas for export

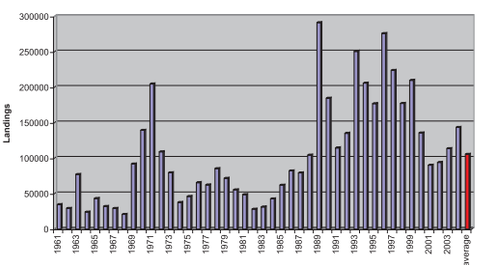
- The total tuna landings along the mainland coast during 2004 were 45,684 t showing a decrease of 12.7% compared to 2003. Southwest region contributed 48.8% followed by southeast (29.6%), northwest (21.1%) and northeast (0.5%).
- Major gears employed in the fishery were drift gillnet, hooks and line and purse seine.
- Major species of tunas landed were *Euthynnus affinis* (45%), *Auxis* spp. (17%), *Katsuwonus pelamis* (7.4%), *Thunnus tonggol* (15.4%) and the rest by other species. Production of *E. affinis* has almost stabilized at around an annual average of 17,000 t and the species is optimally exploited.
- Catch of *T. albacares*, *T. tonggol* and *K. pelamis* are showing an increasing trend since 1996 along the mainland coast especially with many fishing fleets equipped to operate in distant waters.
- The size range of yellowfin tuna landed by drift gill net at Cochin fisheries harbour ranged from 54 to 108 cm, with dominant size group of 90-94 cm.
- Billfish species landed included *Istiophorus platypterus*, *Xiphias gladius* and *Makaira indica*.
- Tuna landings at Minicoy were estimated to be 2575 t showing an increase of 13.2% compared to 2003. *K. pelamis* dominated the pole and line and troll line catches followed by *T. albacares.*
- Among the total tuna landings 58.6% are from FADs, 28.1% from flotsam and the rest from free swimming shoals.
- Size range of *K. pelamis* in the pole and line fishery was 22-64 cm with prominent mode at 48 cm.
- Majority of the skipjack tuna (73.6%) exploited during the year were matured ones, followed by immature 26.3% and juveniles 2.9%.
- Mature and spent (73.6%) skipjack tuna were caught in free swimming schools by pole and line at Minicoy whereas immature tuna started dominating from FADs.

- An export market for yellowfin and skipjack tunas (whole frozen form) has been developed along the mainland coast.
- A collaborative research project entitled, *Tuna resources of the Indian EEZ – an assessment of growth and migratory patterns*, with a total outlay of Rs. 143.92 lakhs has been sanctioned by DOD during 2004-05.

- *Tuna fishing by traditional fishermen targeting yellowfin using hook & line from* catamaran *off Visakhapatnam is picking up.*
- *Large floating devices (*payaos *– type used in Philippines) have been deployed for tuna fishing in the oceanic waters off Nagapattanam, Tamil Nadu.*

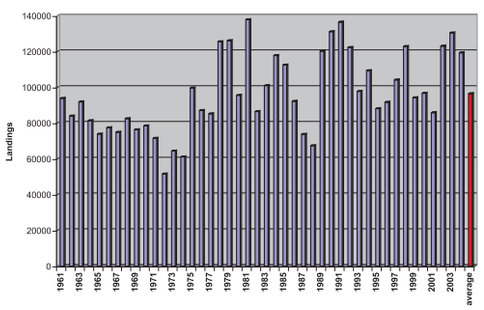
PROJECT CODE	**PEL/CAP/5**
PROJECT TITLE	**Development of Management Strategies and Options for Sustainable Harvest of Mackerels**
SCIENTISTS	**G. Gopakumar,** Mohammad Zafar Khan, Prathibha Rohit, M. Sivadas, P.N. Radhakrishnan Nair, N.G.K. Pillai, E.M. Abdussamad, H. Mohamad Kasim and A.K.V. Nasser
CENTRES	Mumbai, Mangalore, Calicut, Cochin, Mandapam, Tuticorin, Chennai and Visakhapatnam

- The estimated landing of Indian mackerel during 2004 was 1.43 lakh t, which showed an increase by 26% compared to the year 2003.
- A major objective of the project was to investigate the effectiveness of different types of gears for the exploitation of mackerel resource. Gill net, purse seine, trawl net and ring seine were the major gears employed for the exploitation of mackerel along the Indian coasts. The contribution of gillnet to the mackerel catch was 0.2% at Mangalore – Malpe, 0.2% at Calicut, 0.4% at Kochi, 13.1% at Tuticorin, 95.8% at Mandapam, 7.2% at Chennai and 4.1% at Visakhapatnam. Purse seine contributed 55.7% at Mumbai, 80.7% at Mangalore-Malpe and 26.1% at Kochi. The contribution of trawlnet to the total mackerel catch was 44.3% at Mumbai, 19.1% at Mangalore-Malpe, 38.8% at Calicut, 43.1% at Kochi, 86.9% at Tuticorin, 4.2% at Mandapam, 2.4% at Chennai and 32.8% at Visakhapatnam. The multiday trawlers landed 62.3% of the mackerel at Visakhapatnam. Bagnet contributed 90.4% of the mackerel catch at Chennai. Ring seine contributed 60.9% and 30.4% of the mackerel catch at Calicut and Kochi, respectively.
- Size range of mackerel landed in gillnets varied between 105 and 315mm with major modes ranged from 200-240mm. In purse seine it ranged from 55-295 mm with major modes 175 and 230 mm at Mumbai and 220mm at Mangalore – Malpe while in trawl, it ranged from 60 – 290 mm with major modes at 160 and 245mm. In ring seine it ranged from 110-275 mm with major modes at 195 and 245 mm at Calicut and 190 mm at Kochi.
- In most of the gears partially spent fishes dominated the catch.
- Copepods, cladocerans, ostracods, fish eggs, small fishes and squid were noted in the stomach contents.
- The exploitation rates were 0.57 at Mangalore – Malpe (all gears) 0.54 at Calicut (trawl), 0.61 at Mandapam (gill net), 0.06 at Chennai (gill net), 0.4 Chennai (bag net) and 0.65 at Visakhapatnam (all gears).
- No direct impact of *tsunami* on mackerel fishery was noted in any of the centres except Chennai where fishing was suspended during January – February.

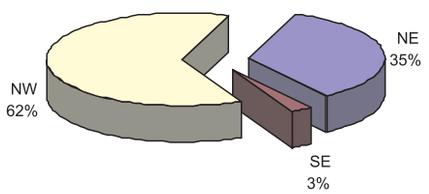


Trend of all India mackerel landings 1961-2004

PROJECT CODE	**PEL/CAP/6**
PROJECT TITLE	**Development of Management Strategies for Sustainable Fishery of Bombayduck**
SCIENTISTS	**Alexander Kurien**
CENTRES	Mumbai, Veraval and Kakinada



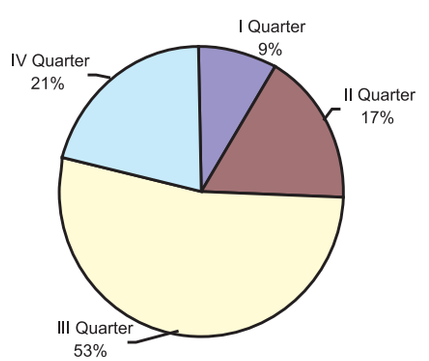
Trend of all India Bombay duck landings 1961-2004



Region wise contribution to Bombay duck landings - 2004

- The Bombay duck after a decreasing phase in production reached 1.30 lakh t in 2003 and then showed a slight decline to 1.2 lakh t in 2004.
- Maharashtra (23.6%), Gujarat (39%) and West Bengal (34%) were the main contributors. Catch from West Bengal (40,669 t) has surpassed the catch from Maharashtra (28,135 t).
- In Maharashtra the production in the artisanal sector was at a C/E of 16 kg compared to 255-3133 kg in the industrial sector.
- In Gujarat, the total *dol* net catch was 39,450 t at a C/E of 66 kg, showing a decrease of 36% over previous year.
- *Harpadon nehereus* was the sole species recorded along the northwest coast, while at Kakinada, *H. squamosus* accounted over 50% of the Bombayduck landings.
- Size range of *H. nehereus* caught in *dol* net varied between 45 and 330 mm (Arnala) while in trawl it ranged from 45-360 mm at New Ferry Wharf (Mumbai).

PROJECT CODE	**PEL/CAP/7**
PROJECT TITLE	**Monitoring of Fishery and Resource Characteristics of Exploited Ribbonfish Stocks and their Management along the Indian Coast**
SCIENTISTS	**P.N. Radhakrishnan Nair,** Mohammad Zafar Khan, C. Muthiah, A.A. Jayaprakash, H. Mohamad Kasim and A.K.V. Nasser
CENTRES	Veraval, Mumbai, Mangalore, Cochin, Chennai and Visakhapatnam

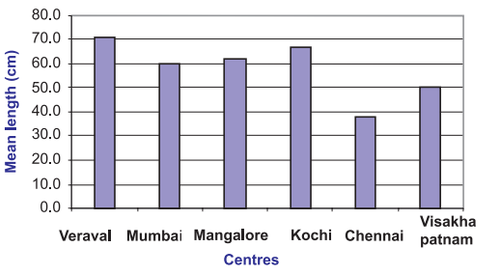


Quarter-wise landings of Ribbonfish 2004-05

- The estimated ribbonfish landings were 1.3 lakh t. The fishery declined in 2004 by 16,500t over 2003. The catch showed a marginal increase only in Gujarat & Goa in the west coast and West Bengal & Orissa in the east coast. But it declined sharply in Maharashtra & Kerala and slightly in Andhra Pradesh & Karnataka.
- Trawl is the major gear in ribbonfish fishery all along the coast of India fetching nearly 99% of the catch. A reduction in effort (trawl units) was noticed at Veraval (19.4%), Mumbai (56%), Mangalore (20%), Chennai (46.8%) and Visakhapatnam (36%). An increase in effort was noticed only at Kochi (22.6%). The landings in trawl decreased considerably in all the centers except at Veraval and Kochi. The peak fishery was during the quarter October to December when 53% of the total landings was recorded.
- The percentage contribution of ribbonfish in the total trawl landings was less and it formed nearly 8.6% against 10.6% in 2003-04. The catch rate in trawl net ranged from a minimum of 91.2kg at Kochi to a maximum of 719.7 kg at Veraval.
- *Trichiurus lepturus* was the only species reported from all the centers.

The 1+ year old fish (50-77cm) dominated in the catch in most of the centers except at Chennai and Visakhapatnam where 0-year class (<50cm) was predominant. The mean length of the catch was 59.8 to 71.0cm in trawl in the west coast landings, but only 37.9 to 58.4cm in the east coast fishery. The minimum size of recruitment was 20cm in trawl and 16cm in boat seine (Visakhapatnam).

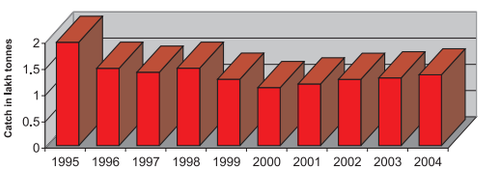
- Studies on the stock structure of *T. lepturus* indicated that the stock had declined. The exploitation ratio ranged from 0.52 (Veraval) to 0.81 (Chennai). At Mumbai and Mangalore it was 0.73 and 0.78, respectively. This shows that the resource is under increased fishing pressure in most of the centres except at Veraval where it is optimally exploited. Decline in production, decreasing trend in the mean length along the east coast, decrease in catch rate and dominance of 0-year are indications that the fishery is under heavy fishing pressure along the east coast. So a reduction in fishing effort is recommended along the east coast.



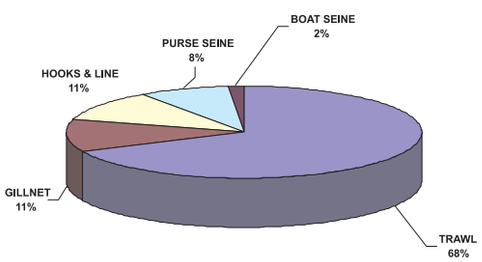
Mean Length of *T.lepturus* at different centres: 2004-05

PROJECT CODE	**PEL/CAP/8**
PROJECT TITLE	**Management of Carangid Resources of Indian EEZ**
SCIENTISTS	**H. Mohamad Kasim,** Prathibha Rohit, A.A. Jayaprakash, E.M. Abdussamad and A.K.V. Nasser
CENTRES	Veraval, Mangalore, Cochin, Tuticorin, Visakhapatnam and Chennai

- The all India carangid production during 2004 increased to 1.35 lakh t, registering 4.5% increase compared to the previous year. The increase in the catch along both east and west coast was mainly due to better abundance and higher effort input.
- At Veraval, Mangalore and Kochi, the trawls were the most dominant gear landing 88.7, 58.1 and 51% of the total carangid catch, respectively. The second dominant gear was gillnet (11.3%) at Veraval and purse seine at Mangalore (41.3%) and Kochi (19.7%). Along the east coast also the trawl landing was dominant at Tuticorin 80.4% and Visakhapatnam 96.8% and the rest being landed by the gillnets of different types.
- Several species sustain the fishery of carangids. *Decapterus russelli* was the dominant species in trawl landings at Veraval (88.1%), Mangalore, Kochi (75%), and Visakhapatnam as also in purse seine (50%) and ring seine (65%) at Kochi. *Megalaspis cordyla* was the dominant species in gillnet landings at Veraval (76.6%), Kochi (31%) and Visakhapatnam and in purse seine and gillnet landings at Mangalore. At Tuticorin *Caranx ignobilis* was the dominant species in *paruvalai* (23%) and hooks & line (60.7%). *C. carangus* was dominant (32.9%) in *podivalai* and *Decapterus* spp., (25.4%) and *S. leptolepis* (10.6%) were the dominant species in trawl.
- Studies on the population dynamics and stock assessment of different component species from the west coast reveal that along Kerala coast, *M.cordyla* is exposed to higher fishing pressure by both gillnet and trawl and *D. russelli* by trawl, whereas *S. crumenophthalmus* is underfished by both trawl and gillnets.

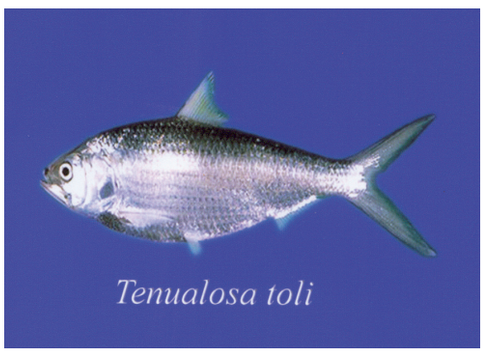


All India average carangid production during 1995 -2004



Gearwise contribution (%) of carangid landings in India (average 1993-2003)

PROJECT CODE	**PEL/BIOD/01**
PROJECT TITLE	**Taxonomy of Marine Pelagic Finfishes**
SCIENTISTS	**Prathibha Rohit,** A.A. Jayaprakash, P.N.R. Nair, E.M. Abdussamad and A.K.V. Nasser
CENTRES	Mangalore, Calicut, Cochin, Tuticorin and Visakhapatnam



A rare clupeid species

- Pelagic finfishes belonging to Clupeidae, Engraulidae, Chirocentridae, Megalopidae, Scombridae, Istiophoridae, Carangidae and Trichiuridae families were collected from different gears operating at Visakhapatnam, Tuticorin, Cochin, Calicut, Mangalore and Malpe.
- Morphometric measurements and meristic counts of ninety-four species of pelagic finfishes belonging to forty-eight genera and eight families were completed during the year.
- Data collected for individual species were tabulated in the prescribed formats.
- *Tenualosa toli* (Clupeidae), *Thryssa malabarica*, *T. vitrirostris* (Engraulidae), *Nucrates doctor* (Carangidae) were some of the rare fishes recorded during the year.
- Type specimens of all the species were preserved in formalin and sent to the biodiversity museum set up at the Institute Headquarters, Cochin.

DEMERSAL FISHERIES DIVISION

- The Demersal Fisheries Division had monitored the fishery and resource characteristics of major demersal fish groups through 8 capture fisheries projects. The species diversity of a few selected families of demersal fishes was studied through a project on taxonomy.
- The broodstock development, breeding and larval rearing of groupers and marine ornamental fishes along with live feed culture were attempted.
- The Division completed 2 sponsored projects during this year and continued participation in 3 other sponsored projects. The Scientists of the Division were involved as Co-ordinators in the Winter School on " Ecosystem Based Fisheries Management" and also as Co-investigator in an NATP project.
- The all India demersal fish landings during 2004 was 6,69,990 t (6.7 lakh t) which contributed to 25.8 % of the total marine fish landings of the country. The demersal fish landings indicated an increase by 5 % when compared to that of 2003. The major groups contributed to the all India demersal fish landings were the elasmobranchs (9.1 %), catfishes (8 %), lizardfshes (5.4 %), major perches (5.5 %), threadfin breams (17.8 %), croakers (18.1 %), silverbellies (7.9 %) pomfrets (5.9 %), flatfishes (5.4 %) and goatfishes (2.4 %).

PROJECT CODE	**DEM/CAP/01**
PROJECT TITLE	**Investigations on the Resource Characteristics of the Exploited Stocks of Elasmobranchs**
SCIENTISTS	**S.G. Raje,** G. Mohanraj, A. Raju, K.K. Joshi and P.P. Manojkumar
CENTRES	Mumbai,Calicut, Mandapam and Chennai

- The estimated landings of elasmobranchs in India amounted to 60,984 t contributed by sharks (61.4 %), skates (5.69 %) and rays (32.95 %). The elasmobranchs contributed to 9.1 % of the total demersal fish landings in the country. Sharks were landed more from Tamil Nadu (9822t), Gujarat (11,402 t) and Maharashtra (6189 t). Rays formed the maximum landings from Tamil Nadu (10,834 t) while skates were landed more from Gujarat (1,159 t).
- Centrewise, Mumbai landed the maximum of elasmobranchs (1973t) followed by Mandapam (1713 t), Chennai (673 t) and Calicut (574 t). Trawl was the major gear to exploit this resource (75.5%) followed by gillnet (12%), hooks and line (10%) and dol net (1.2%). A total of 21 species of sharks, 18 species of rays and 7 species of skates were represented in the fishery. *Scoliodon laticaudus* (72%), *Himantura uarnak* (23%) and *Rhynchobatus djiddensis* (90%) were the dominant species among sharks, rays and skates, respectively landed by trawl net from all the centres.
- The catch in gill net was dominated by *S. laticaudus* (39%), H. *bleekeri* (29%) and *R. djiddensis* (89%) among their respective groups from all the centres. *Carcharhinus limbatus* (44%) was the most dominant species among sharks landed by hooks and line followed by *Sphyrna zygaena* (31%), *Carcharhinus melanopterus* (21%) and *C. sorrah* (2%). *S. laticaudus* accounted for 58% of the shark landing in dol net followed by *Rhizoprionodon acutus* (30%), *R. oligolinx* (8%) and

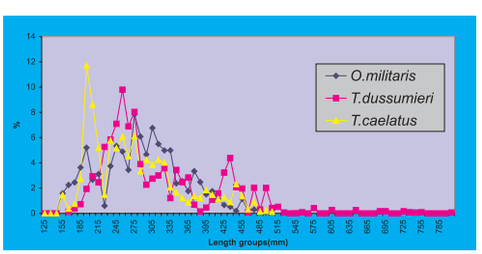
Significant findings

- *The elasmobranch fishery in India contributed to 9.1 % of the total demersal fish landings in the country during 2004. Sharks formed 61.4 %, while rays and skates contributed to 32.95 % and 5.69 %, respectively.*
- *Tamil Nadu contributed to the maximum of sharks and rays landings.*
- *A total of 21 species of sharks, 18 species of rays and 7 species of skates were represented in the fishery.*
- *S. laticaudus among sharks, H. uarnak among rays and R. djiddensis among skates were the dominant species landed in trawl net.*
- *Off Mumbai, females of S. laticaudus and A. imbricatus caught in trawl were larger than males.*
- *Rare landings of oceanic shark Alopias vulpinus at 100 m depth off Malabar coast is reported.*

Lamiopsis temminckii (3%). Off Mumbai, the mean size of females of *S. laticaudus* and *Amphotisteus imbricatus* caught in trawl was higher than that of the males. The range of litter size noticed was 9 – 18 numbers in *S. laticaudus*, 2 – 4 in *C. sorrah*, 2 – 5 in *Rhizoprionodon oligolinx*, 2 – 3 in *R. acutus*, 1 – 3 in *A. imbricatus*, 7 – 10 *in R. djeddensis* and 6 – 9 in *R. annandalei.*

- Off Calicut, the elasmobranchs landings declined from 852 t of 2003 to 583 t during 2004 probably caused by a reduction in effort by trawl and long line. In trawl off Calicut, *Sphyrna zygaena* (46%) among sharks and *Aetobatus narinari* (57%) among rays dominated. *C. limbatus* was the dominant species among sharks caught in gill net and long line. *C. limbatus* and *S. zygaena* caught in long line was larger than those caught in trawl. Stock assessment studies made at Calicut indicated that *C. limbatus* had an $L\alpha$ of 290 cm, and K of 0.38/yr. Exploitation ratio (E) of the species obtained is 0.67, which is less than the E_{max} of 0.74 indicating that the species off Malabar coast is underexploited. The growth parameters estimated for *S. zygaena* were $L\alpha$ = 375 cm and K = 0.27/yr. Rare landings of oceanic shark *Alopias vulpinus* (24.5 t) from 100 m depth off Malabar coast was reported.
- Off Mandapam, the total production of rays was 1713. 4 t brought by trawlers (85%) and gill net (15%). *H. bleekeri* (38%) and *H. uarnak* (36%) were the dominant species in gill net and trawl, respectively. Off Chennai, trawlers accounted for 73% of the total elasmobranch catch of 673 t. Rays, the major group landed was dominated by *Dasyatis* spp (73%).

PROJECT CODE **DEM/CAP/02**
PROJECT TITLE **Monitoring the Resource Characteristics of Groupers and Catfishes**
SCIENTISTS **N.G. Menon,** Grace Mathew and Paramita Banerjee
CENTRES Mumbai, Cochin and Tuticorin



Length frequency distribution of major species of catfishes landed in trawl off Mumbai.

Groupers:

- With an annual landing of 18,213 t, the all India grouper production during 2004 indicated an increase by 7.8 % when compared to that of 2003. Grouper landings were maximum from Kerala (5785 t) followed by Maharashtra (3791 t).
- Centrewise, Tuticorin brought maximum catch of groupers (1011t) caught by trawlers (384 t) and hooks and line (627 t). *Epinephelus malabaricus* contributed to the bulk of the grouper catch off Tuticorin in hooks and line followed by *E. undulosus, E. longispinis, E. tauvina, E. areolatus* and *Cephalopholis sonnerati*. In trawl off Tuticorin, E. *undulosus* was the major species landed**.** At Tuticorin, *E. tauvina* and *E. malabaricus* weighing more than 10 kg had a price range of Rs. 90 – 300/Kg due to export demand.
- At Mumbai, a total of 651 t of groupers were landed in trawl net from New Ferry Wharf (79.25%) and Versova (20.75%). *E. diacanthus* dominated the catch followed by *E. tauvina* and *E. latifasciatus*.
- At Cochin, a total of 94t of groupers were landed by gillnet (89.7%) and trawl net (10.3%). *E. diacanthus* was the major species landed

at Cochin. About *35% of E.diacanthus* observed were indeterminates. Lα and K of *E. diacanthus* at Cochin were 490mm and 0.06/yr, respectively.

Catfishes

- All India catfish landings during 2004 amounted to 53712 t. Catfishes contributed to 8% of the all India demersal fish landings during 2004. Gujarat (22,048 t), West Bengal (7786 t), Maharashtra (9110 t) and Orissa (4718 t) were the major contributers to all India catfish landings.
- Centrewise, the trawl landings of catfish at New Ferry Wharf (1489 t) and at Versova (932.4t) together amounted to 2421.7 t. *Osteogeneosus militaris* (40.34%) formed the major species landed off Mumbai followed by *Tachysurus dussumieri* (24.30%), *T. caelatus, T. tenuispinis, T. sona, T. thalassinus* and *T.serratus*. *O.militaris* landed in trawl had a length range of 155 –495mm (mode at 275mm). The size range of *T.caelatus* was 155-505mm (mode: 195mm) while *T.dussumieri* had a size range of 165-805mm (mode 255mm).

PROJECT CODE	**DEM/CAP/03**
PROJECT TITLE	**Characteristics of Exploited Stocks of Threadfin Breams and Silverbellies**
SCIENTISTS	**P.U. Zacharia,** S. Sivakami, E. Vivekanandan, K.V.S. Nair, A. Raju and P.P. Manojkumar
CENTRES	Veraval, Mangalore, Calicut, Cochin, Mandapam and Chennai

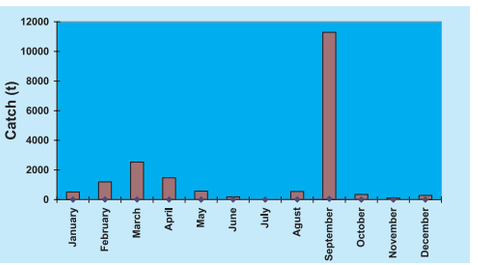
Threadfin breams:

- All India threadfin bream landings during 2004 was 1,18,899 t which formed 17.8 % of the total demersal fish landings of the country. Kerala contributed to the maximum of 46,466 t followed by Maharashtra (25,994 t) and Karnataka (19,812 t). Centrewise, Mangalore brought highest catch of 19032t followed by Calicut (8626t) Veraval (6808 t) and Cochin (1771 t). Off Mangalore, peak landing of threadfin breams was recorded during September when MDF units operated in deeper waters to catch cuttle fish and threadfin breams**.**
- Off Calicut, nemipterid landings (8626 t) increased this year by 24% when compared to that of 2003. Two peaks in landings during March – May and during August – September were noticed off Calicut. The decline in landing after the second peak indicates their probable migration to deeper waters.

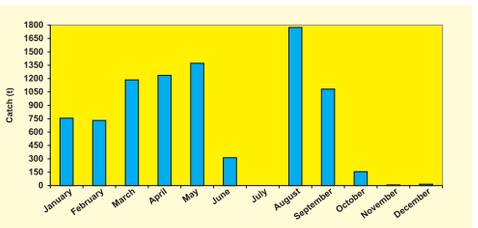
➢ *Nemipterus japonicus* (63%) and *N. mesoprion* were the major species off Calicut. The size of *N. japonicus* off Calicut ranged between 70 – 319 mm (mean size: 154mm). Growth parameters of the species were Lα = 330 mm and K= 0.92/yr. Exploitation rate (E) *of N. japonicus* was 0.77 which is more than the E max = 0.54 which indicates that the species is over exploited off Malabar coast.

Silverbellies

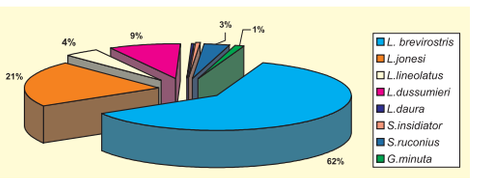
▪ The All India landings of silverbellies during 2004 were 52,827 t, which contributed to 7.9 % of the total demersal fish landing of the country. Tamil Nadu contributed to the maximum (62.1%) of silverbellies landings. Centrewise, Mandapam brought highest



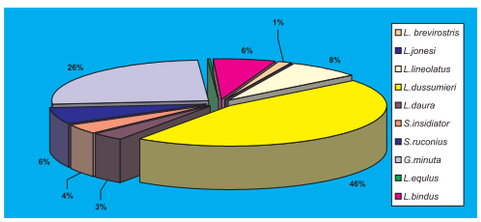
Monthwise landings of threadfinbreams at Mangalore during 2004



Monthwise landings of threadfinbreams at Calicut during 2004



Species composition of silverbellies landed off Palk Bay during 2004



Species composition of silverbellies landed off Gulf of Mannar during 2004

Significant findings

- *The All India threadfin bream landings of 1,18,899 t contributed to 17.8 % of the total demersal fish landings of the country.*
- N. japonicus *was the dominant species at Veraval and Calicut while off Cochin and Mangalore,* N. mesoprion *was the major species landed.*
- *Occurrence of nemipterids in deeper waters during the 4th quarter of the year is indicated off Calicut and Mangalore.*
- N. japonicus *off Malabar coast was overexploited as evidenced by higher exploitation Rate (0.77).*
- *Silverbellies landings were represented by 12 species dominated by* L. bindus *off Chennai,* S. insidiator *off Mangalore and* L. brevirostris *off Palk Bay and* L.dussumieri *off Gulf of Mannar.*

landings of 9833 t, followed by Mangalore (1196 t) and Chennai (1134 t). A total of 12 species were represented in the landings dominated by *Leiognathus bindus* off Chennai and *Secutor insidator* off Mangalore.

- Off Mandapam, the fishery was contributed by 8 species from Palk Bay dominated by *L.brevirostris* and by 10 species off Gulf of Mannar dominated by *L.dussumieri*.

PROJECT CODE **DEM/CAP/04**
PROJECT TITLE **Investigations on the Resource Characteristics and Sustainable Production of Sciaenids**
SCIENTISTS **G. Mohanraj,** K.V.S. Nair and Paramita Banerjee
CENTRES Veraval, Mumbai, Chennai and Kakinada

Otolithus ruber, a species of economic importance

- The All India sciaenid landing during 2004 was 1,21,597 t which contributed to 18.1 % of the all India demersal fish landings. Gujarat (40,087 t) followed by Maharashtra (29,662 t) was the major contributors to the all India sciaenid landings. Centrewise, maximum landings was brought from Mumbai (11117 t) followed by Veraval (3997 t), Kakinada (1288 t) and Chennai (594 t). Off Veraval, the sciaenid landing was brought by trawl net (85%), gill net (4%) and dol net (11%). At Kakinada, the catch was brought by trawl (91%) and gillnet (9%). At Mumbai and Chennai, the entire catch was brought by trawl**.**
- *Otolithus cuvieri* at Veraval, *Otolithoides biauritus* off Mumbai, *Otolithus ruber* off Chennai and *Nibea maculata* off Kakinada were the dominant species landed**.** A total of 18 species were represented

in the catches at Chennai and 17 at Kakinada while off Veraval and Mumbai, a total of 10 and 12 species were represented, respectively. Off Veraval, *O.cuvieri* sampled had a modal size of 180-189mm while for *J.glaucus* the modal size was 160-169mm.Off Mumbai, the dominant model size were 174.5mm and 194.5mm for *J.vogleri.* At Chennai, the modal size for *O.ruber* was 185mm while it was 155mm for *J.carutta*.

Length range (mm) & dominant modes of major spp. of sciaenids landed in trawl at various centres

Species	Centre	Length range (mm)	Dominant modal size group (mm)
Johnieops sina	Mumbai	104-234	144.5
J. volgeri	Mumbai	94-304	174.5 & 194.5
J. macrorhynus	Mumbai	94-304	194.5 & 204.5
Johnius carutta	Chennai	120-209	150-159
J. glaucus	Veraval	80-279	160
J. dussumieri	Mumbai	114-304	144
Otolithus cuvieri	Veraval	90-289	180
,,	Mumbai	104-384	154.5 & 174.5
Otolithus ruber	Kakinada	45-395	165
,,	Chennai	120-309	185
Otolithoides biauritus	Mumbai	164-1504	404.5
Protonibea diacanthus	Kakinada	210-1400	810-1000
,,	Mumbai	164-1104	244.5

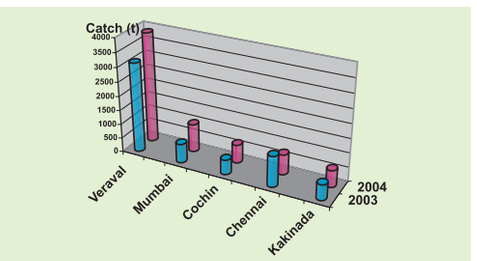
PROJECT CODE DEM/CAP/05

PROJECT TITLE **Resource Characteristics and Stock Assessment of Lizard fishes, Bullseye and Pomfret Resources**

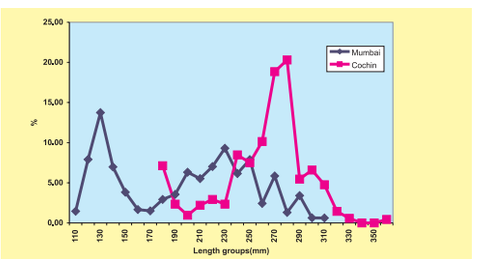
SCIENTISTS **S. Sivakami,** S.G. Raje, E. Vivekanandan and K.V.S. Nair

CENTRES Veraval , Mumbai, Cochin, Chennai and Kakinada

- The All India lizard fish landings during 2004 amounted to 35,911 t, which formed 5.4 % of the total demersal fish landings of the country. Kerala landed the maximum of 13,373 t followed by Gujarat (8146 t). Centrewise, the lizardfish landings during 2004 indicated an increasing trend at Veraval (3151.4t to 3879.4t.of 2003, 23% increase), Mumbai (from 666t to 988t, 48% increase), Cochin (516t to 645 t, 25% increase) and at Kakinada (543 t to 595 t, 9% increase). The increase in landings is attributable to increase in multi-day fishing especially off Cochin.
- Off Chennai, there was a decline from 1079t to 710t this year (34% decrease) with a corresponding decrease in effort by 42.4 %. *Saurida tumbil* was the dominant species at all the centers except as Chennai, where *S. undosquamis* was the major species landed.
- Seasonally lizardfish was landed more during September off Veraval, during October-November off Mumbai, May, August & September off Cochin, April and June & July off Chennai & during June-August off Kakinada. Growth & mortality parameters estimated for *S. tumbil* & *S. undosquamis* at various centers indicate that Exploitation rate



Lizardfish landings at various centres during 2003 & 2004



Length frequency distribution of *P.hamrur* at Mumbai and Cochin

Significant findings

- *Lizardfish landings (35,911 t) contributed to 5.4 % of the total demersal fish landings of the country during 2004.*
- *Kerala contributed the maximum lizardfish landings in India.*
- *Lizardfish fishery indicated general increasing trend at all the centres except at Chennai.*
- S. tumbil *was the dominant species at all centres except at Chennai where* S. undosquamis *was the major species landed.*
- *Growth and mortality parameters estimated for* S. tumbil *and* S. undosquamis *at various centres indicate that their exploitation rate is high.*
- P.hamrur *landed off Mumbai were of smaller size than those caught at Cochin.*
- *Pomfret, a multigear resource off Mumbai was landed more in trawlnet than in gillnet and dolnet.*

is high suggesting reduction in effort for a sustainable fishery.

- Bull's eye (Family: Priacanthidae) landings was showing an increasing trend at Cochin (126t of 2003 to 226 t this year). Off Mumbai, the catch declined from 195.8 t to 116 t while off Veraval, the decline was from 348 t to 322t. *Priacanthus hamrur* was the dominant species with *Cookeolus boops* landing sporadically off Cochin. *P.hamrur* landed off Mumbai were of smaller size (110-310mm;mean size: 197mm) than those landed off Cochin (180-370mm mean size: 270 mm**).**
- Ripe/Spent ovaries of *P.hamrur* were noticed off Cochin during August and September to October period with females dominating the population. Pomfrets, being a multigear resource off Mumbai, was landed more in trawl (462t) than in gill net off Satpati (232t) and in dolnet (395 t) off Vasai. The catch indicated an increase by 26 % in trawl, but declined in gill net (18%) & in Dol net (59.4%). Off Veraval, pomfret landings in trawl was 158 t and in gill net the catch was 150 t. *Pampus argenteus* was the major species landed followed by *Formio niger* in all the gears. *P. argenteus* caught in gill net (mean size = 207.26mm) & Dol net (205mm) off Mumbai were larger than those caught in trawl (118.5 mm).

PROJECT CODE **DEM/CAP/06**
PROJECT TITLE **Fishery and Resource Characteristics of Flatfishes and Goat fishes**
SCIENTISTS **E. Vivekanandan,** K.V.S. Nair, P.U. Zacharia, P.P. Manojkumar and Rekha J. Nair.
CENTRES Veraval, Mangalore, Calicut, Cochin and Chennai

Flatfishes :

- The estimated flatfish landings in India during 2004 amounted to 36,202 t, which contributed to 5.4 % of the total demersal fish landings.
- Kerala contributed to the maximum of 16,349 t followed by Karnataka (5,885 t).
- Centrewise, the estimated landings of flatfishes by trawlers at Calicut, Mangalore and Malpe were 2025 t, 726t and 622t, respectively. At Karwar including Tadri a total of 1980 t of flatfish was landed.
- *Cynoglossus macrostomus* was the dominant species at all the centres contributing to 80 to 92% of the flatfish landings.
- The length range of C. *macrostomus* was 40 – 154 mm (mean length: 103 mm) at Calicut, 55 – 169 mm (mean length – 119 mm) at Mangalore and 55 – 164 mm (mean: 119 mm) at Malpe.

Species composition (%) of flatfishes and goatfishes landed at various centres during 2004.

Species	Flatfishes Calicut	Mangalore & Malpe	Species	Goatfishes Chennai	Visakhapatnam
C. macrostomus	92	80.1	***Upeneus taeniopterus***	52	0
C.dubius	3.9	0	***U. sulphureus***	30.6	25
C. bileneatus	0.2	4.41	***U.molluccensis***	8.5	12.3
C.arel	3.9	2.33	***U. tragula***	0	0.6
C. puncticeps	0	2.97	***U.bensasi***	***8.9***	0
Psettodus erumei	0.1	8.6	***U. vittatus***	0	62
P. arsius	0	1.6	***Parupeneus indicus***	0.1	0
Total catch(t)	**2025**	**1348.216**	**Total Catch (t)**	**523**	**3310**

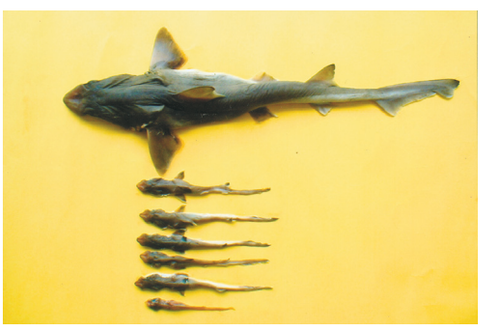
- Lα and K for *C. macrostomus* off Calicut were 164.5 mm and 0.7/yr, respectively. The total, natural and fishing mortalities were 3.01, 0.86 and 2.15, respectively. E. ratio was 0.79.

Goatfishes

- The all India goatfish landings during 2004 were 16,318 t, which formed 2.4 % of the total demersal fish landings of the country. Tamil Nadu (5,885t) and Andhra Pradesh (4,668t) contributed to the maximum of goat fish landings. Centrewise, Visakhapatnam brought higher catches of 3310t followed by Chennai (523t). *Upeneus taeniopterus* (52%) and *U. sulphureus* (30.6%) were dominant in the landings at Chennai, while off Visakhapatnam, *U. vittatus* (62%) and *U. sulphureus* (25%) were the major species landed. The length range and mean length of *U. taeniopterus* was 80 – 179 mm and 127 mm, respectively at Chennai. At Visakhapatnam, the length range of *U. vittatus* was 90 – 199 mm.

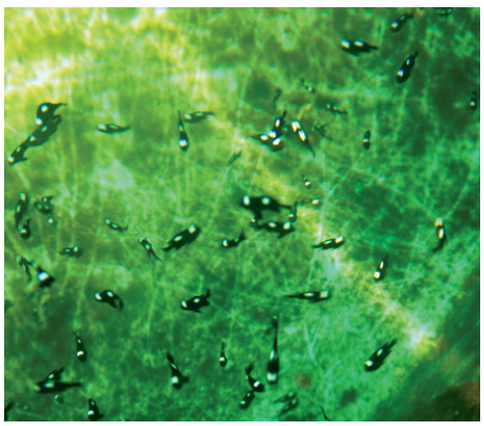
PROJECT CODE	**DEM/BIOD/01**
PROJECT TITLE	**Taxonomy of demersal fishes of India**
SCIENTISTS	**K.K. Joshi,** P.U. Zacharia, G. Mohanraj, P.P. Manojkumar and Rekha J. Nair
CENTRES	Mangalore, Calicut, Cochin and Chennai

- At Mangalore, data on morphometric and meristic characters of 6 species of flatfishes and 3 species of nemipterids were collected. At Calicut, 3 species of the family Cynoglossidae and 6 species of the family Sciaenidae were studied for their morphometric and meristic characters.
- At Cochin taxonomic characters were studied in 5 species of the family Nemipteridae , 2 species of the family Soleidae and 3 species belonging to be family Cynoglossidae. At Chennai, similar studies were made in 4 species of the family Mullidae and 12 species of the family Sciaenidae.
- A rare species of the Snaggletooth shark *Hemipristis elongatus* (Family:Hemigaleidae) was identified off Calicut.



Hemipristis elongatus along with young ones landed at Malabar coast

PROJECT CODE	**DEM/CUL/01**
PROJECT TITLE	**Marine Finfish Culture**
SCIENTISTS	**L. Krishnan,** G.Gopakumar, D.C.V. Easterson, A. Raju, D. Noble, Molly Varghese, Imelda Joseph and K.S. Shobana.
CENTRES	Cochin, Tuticorin and Mandapam



Hatchery reared *Dascyllus trimaculatus*

- At Cochin, repeated spawning of clownfish breeders of *Amphiprion sebae* could be achieved. A total of 14 spawnings from 2 pairs of *A. sebae* were obtained during June – September and during November to December months with 60% survival of larvae.
- Successful production and survival of a batch of 77 juveniles of the three spot damsel *Dascyllus trimaculatus* could be achieved at Mandapam. The larvae metamorphosed during 35th to 40th day of hatching. The metamorphosed young ones measured 1.2 to 1.3 mm. The larviculture and development of second generation of hatchery produced *D. trimaculatus* are being continued.
- Grouper *Epinephelus merra* spawned in captivity at Mandapam.
- Mass culture of rotifers *Brachionus rotundiformis*, *Moina macrura* and *Artemia salina* were developed in the hatchery.

CRUSTACEAN FISHERIES DIVISION

The Crustacean Fisheries Division implemented 7 in-house and 4 external funded projects during 2004-05. The gearwise and species-wise fishery resources data and biological information on commercially important and edible penaeid and non-penaeid shrimps, lobsters and crabs collected from selected fish landing centres along the Indian coast were analysed and suitable management measures for sustainable exploitation of the resource were suggested. Under the Mariculture projects seed production and sea ranching of *Penaeus semisulcatus* were continued at Mandapam. The spiny and slipper lobster breeding and larval culture were also continued and the food and feeding schedules standardized for different larval stages of the slipper lobster *Thenus orientalis*. Under the MPEDA funded project on 'Participatory management and conservation of lobster resources along the southwest coast of India' a public campaign to educate fishermen on conservation of lobster resources was organized in 40 fishing villages along the east coast of Tamil Nadu. The Scientists of the Division were actively involved in teaching and research guidance of the PGPM programme on Mariculture.

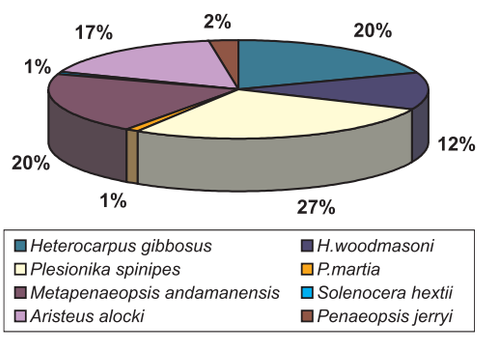
The estimated landings of crustacean resources during 2004 (shrimp, lobsters, crabs and stomatopods) was 3,66,435 t which formed 14.1% of total marine fish production of India. Compared to previous year the crustacean landings declined by 15.4% (66546 t).

Penaeid shrimps formed 47.9% of the total crustacean landings followed by non-penaeid shrimps (31.7%), lobsters (0.4%), crabs (11.2%) and stomatopods (8.8%).

PROJECT CODE	**CRU/CAP/01**
PROJECT TITLE	**Investigations on the Fishery and Biological Characteristics of Exploited Penaeid Shrimp Stocks**
SCIENTISTS	**G.Nandakumar,** Josileen Jose, P.T.Sarada, A.P.Dineshbabu, V.S. Kakati, V.D.Deshmukh, Joe K. Kizhakudan, M. Rajamani, K. R. Manmadhan Nair, K. Asokakumaran Unnithan, G.Maheswarudu, K.N.Saleela and Rekha Devi Chakraborty
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Neendakara, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

The estimated All-India penaeid shrimp catch for the year 2004 was 1.76 lakh t which formed 48% of the crustacean landings of the country and 72% of the catch was caught along the west coast. Important maritime states, which contributed to the penaeid shrimp fishery, were Maharashtra (32%), Kerala (17%), Gujarat (16%), Andhra Pradesh (10%) and Tamil Nadu (8.5%). Mechanised boats operating otter trawl landed about 90% of the catch.

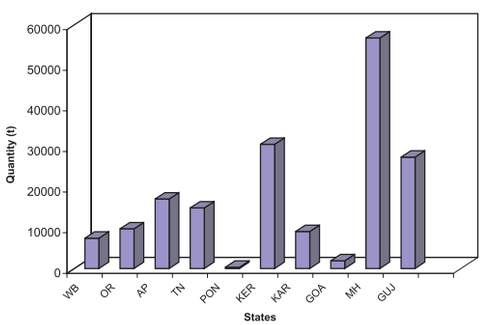
- Penaeid shrimp landing at Veraval amounted to 1872 t with catch rate of 0.96 kg/hr showing an increase of 30% in catch and 59% in catch rate. *Solenocera choprai* (34%) and *S. crassicornis* (27%) were the major contributors to the fishery. Peak months of breeding were December, January and February for *S. crassicornis* and April, September and October for *S. choprai.*
- An estimated catch of 14452 t of penaeid shrimps was landed by trawlers at New Ferry Wharf, Mumbai at a catch rate of 8.1 kg/hr showing a decline of 9% in catch and 12% in catch rate from last year. *Metapenaeus affinis, Parapenaeopsis stylifera, S. crassicornis,*



Species composition of deep sea prawns landed at Cochin

M. monoceros and *Metapenaeopsis stridulans* formed bulk of the catch. Stocks of *P. stylifera*, *M. stridulans*, *M. kutchensis*, *M. brevicornis and Fenneropenaeus merguiensis* (E = 0.63-0.72) were heavily exploited and that of *M. affinis* (E=0.56) and *M. monoceros* (E=0.54) were optimally exploited. Except *M. stridulans* all the species exhibited two breeding peaks and one of them strongly contributed to the fishery depending on the environmental factors.

- An estimated 3696 t of penaeid shrimps were landed at Mangalore and Malpe fisheries harbours during 2004-05 with a catch rate of 1.7 kg/hr which showed an increase of 23% in quantity and 13% in catch rate. *Metapenaeus monoceros* (49%) was the dominant species followed by *S. choprai* (25%), *M. dobsoni* (12%) and *P. stylifera* (9%).
  Parapenaeus fissuroides indicus (Crosnier, 1985) was recorded for the first time from Indian waters. Peak breeding seasons for *M. monoceros* and *M. dobsoni* were December-May and November-March, respectively. Deep-sea trawlers landed 325 t of *Aristeus alcocki* and 16 t of *Heterocarpus gibbosus.*



Statewise landing of penaeid shrimps

- At Calicut, penaeid shrimp catch (960 t in Puthiappa and 1048 t at Beypore) and catch per unit showed an increasing trend. *M. dobsoni*, *M. monoceros*, *F. indicus*, *P. stylifera* and *Trachypenaeus curvirostris* were the important constituents. Exploitation rate (0.68-0.79) indicated high fishing pressure on *P. stylifera* and *M. dobsoni.*

- The estimated shrimp catch at Cochin was 2686 t with a catch rate of 4 kg/hr. *M. dobsoni* (54%) and *P. stylifera* (40%) were the main constituents of the fishery. Mini-trawl operation at Chellanam in nearshore waters yielded 111 t of penaeids (*P. stylifera*: 61% and *M. dobsoni*: 39%) consisting of 43-54% juveniles.

Parapenaeus fissuroides indicus Crosnier, 1985, a new record from Indian waters

- In the deep-sea shrimp catch (2113 t) smaller varieties such as *Metapenaeopsis andamanensis* (37%) and *Plesionika spinipes* (24%) were caught more due to fishing in lesser depths (140-160 m). Other contributors were *H. gibbosus* (11%) and *H. woodmasoni* (10%) and *A. alcocki* (4%).

- Shrimp catch from inshore grounds landed at Sakthikulangara was 5823 t, which showed a decrease of 5% in comparison to the previous year *P. stylifera* (71%) predominated the catch. In comparison to the previous season (2003-04), deep-sea shrimp catch declined drastically by 68% (11727 t) due to decrease in effort (3610 units) during December-March immediately after tsunami and reduction in catch by 4371 t in September and 2554 t in November.

- *Penaeus semisulcatus* (77%) predominated the shrimp catch (155 t) at Tuticorin. Peak breeding period was October-November. Lesser number of trawlers was operated during January-February ’05 after the tsunami. Deep-sea shrimps caught by trawlers during October-March amounted to 3268t, comprising *Solenocera hextii*, *H. gibbosus*, *P. spinipes* and *P. martia* in order of abundance.

- The estimated shrimp landings by trawlers at Kasimedu (Chennai) were 1228 t. *M. dobsoni*, *F. indicus* and *M. monoceros* were the important constituents. After tsunami, trawling was resumed only in the last week of March ’05. During August-December, trawlers landed

111 t of deep-sea shrimps and *S. hextii* dominated the catch.

- At Kakinada, more than 21 species were present in penaeid shrimp catch amounting to 4447 t of which *M. dobsoni* (30%) and *M. monoceros* (23%) were major contributors. Peak breeding months for *M. dobsoni* were February and March.
- Penaeid shrimp catch of small mechanised trawlers (1018 t) and Sona boats (2833 t) at Visakhapatnam declined due to decrease in effort. Important fishing months were July-October and January-March. *M. dobsoni*, *Metapenaeopsis* spp. and *M. monoceros* were the important contributors to the shrimp fishery. Peak breeding seasons were June-July and February-March for *M. monoceros* and October-November for *M. dobsoni.*

PROJECT CODE	**CRU/CAP/02**
PROJECT TITLE	**Stock Assessment and Management of Non-Penaeid Shrimp Resources of India**
SCIENTISTS	**V. D. Deshmukh,** K. Asokakumaran Unnithan, Miriam Paul and Rekha Devi Chakraborty
CENTRES	Mumbai, Veraval and Kakinada

Studies on resource characteristics of non-penaeid shrimp were carried out from Veraval, (Nawabundar, Rajpara and Jaffrabad: Saurashta zone) in Gujarat, New Ferry Wharf (NFW), Sassoon docks and Arnala from Mumbai in Maharashtra and Bhairva Palem from Kakinada in Andhra Pradesh. Investigations on the resource were carried out from *dol* (bag) net and trawl landings in Mumbai and Veraval and from the trawl landings at Kakinada. Biology of the constituent species was studied from Nawabundar, New ferry wharf, Arnala and Bhairva Palem.

The total estimated non-penaeid shrimp landing in 2004 was 1,16,231 t as against 1.37,229 t in 2003.

Dol net fishery

- The non-penaeid shrimps contributed 26-35% to the dol net fishery.
- During 2004-05, these shrimps recorded decline in Mumbai (22%) and Saurashtra zone (30%) when compared to last year.
- The estimated catch and the catch rate of non-penaeid shrimps during the year was 16,420t (23 Kg/haul) in Saurashta zone, 150t (7 Kg/haul) at NFW and 558t (10.2 Kg/haul) at Arnala; the catch declined by 22% at both NFW and Arnala and by 30% at Nawabundar, Rajpara and Jaffrabad when compared to 2003-04. The decline was mainly evident in the catch of *Acetes* spp.
- *Acetes* spp. contributed to total non-penaeid shrimp by 40% in Saurashtra zone, 78% at NFW and 52% at Arnala landing centre; peak landings were noticed in October and April.
- *Nematopalaemon tenuipes* contributed 51%, 15.4% and 41.7% in Saurashtra, NFW and Arnala, respectively and maximum catch was recorded in January, April and September.
- *Exhippolysmata ensirostris* contributed 9%, 6.6% and 6.1% at the landing centres in the same order. Peak landings were noticed in January and October.
- *Exopalaemon styliferus* was landed at Arnala only.

Trawl fishery

- Trawl fishery improved along the Gujarat-Maharashtra coast but declined in Andhra Pradesh.
- Trawlers at Veraval, NFW and Kakinada landed 9,393 t, 5400t and 972 t, respectively recording 38% and 39% increase at the former and 53% decline in the catch rate at the latter centre. At Kakinada the trawl catch included 449 t of *Parapandalus longicauda* from100-150m depth.
- At Veraval, *Acetes* spp formed the bulk of the catch (98%) while at NFW, *N. tenuipes* formed the entire catch. At Kakinada, deep sea prawn *P. longicauda* was the dominant species (45%) followed by *N. tenuipes* (29%), *E. ensirostris* (15%) and *Acetes* spp. (11%).

Biology

- Biological studies on size, sex and maturity carried out at all the centres for *N. tenuipes* revealed that April and September are the two breeding peaks for the species along the northwest coast and a single peak during July-October along the east coast.
- *E. ensirostris* showed spawning peaks in May and September in Mumbai and April and November at Navabundar in Saurashtra zone of Gujarat.
- Length-weight relationship for *E. styliferus* collected from Arnala landing centre was estimated separately for the two sexes.

Stock assessment

- *N. tenuipes* showed two major cohorts emanating from pre-monsoon and monsoon spawning but the latter largely contributed to the fishery.
- Mortality parameters for male and female *N. tenuipes* were Z=7.9 and 7.0 and F= 4.6 and 3.6 indicating exploitation ratios 0.58 and 0.52, respectively.

PROJECT CODE	**CRU/CAP/03**
PROJECT TITLE	**Investigations on the Resource Characteristics and Development of Management Strategies for Lobsters and Crabs**
SCIENTISTS	**Mary K.Manisseri,** V.D.Deshmukh, M. Rajamani, K.R. Manmadhan Nair, K. Asokakumaran Unnithan, K.K.Philippose, P.T.Sarada, A.P. Dineshbabu, Joe K. Kizhakudan, S. Lakshmi Pillai, K.N. Saleela and Rekha Devi Chakraborty
CENTRES	Cochin, Veraval, Mumbai, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai and Kakinada

- The estimated total landing of lobsters in 2004 was 1438 t as against 1245 t landed in 2003. This formed 0.43% of the total edible crustaceans landed during the year.
- The total landing of crabs by trawlers in the year was 41,033 t as against 42,117 t in the previous year. *Charybdis feriatus* predominated the fishery along the north-west coast, *Portunus sanguinolentus*, along the coasts of Karnataka, Kerala and Andhra Pradesh and *P. pelagicus* and *P.sanguinolentus* in Tamilnadu.
- At Veraval, lobster landing (*Thenus orientalis* & *Panulirus*

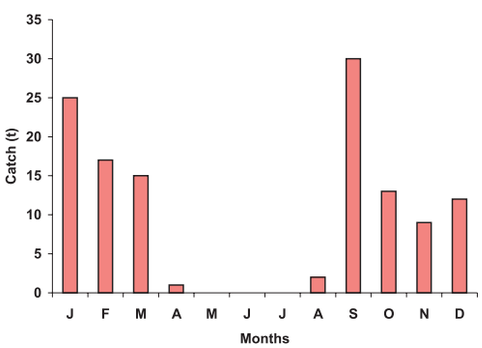
polyphagus) further declined from 10.1 t in 2003 to 8.7 t in 2004 with a catch per unit effort of 0.3 kg. *T. orientalis* continued to be the dominant species constituting 68% of the landing. Sizes ranged from 36 to 100 mm and 56 to 90 mm (CL) in *T.orientalis* and *P. polyphagus*, respectively, with females dominating the catches in both the species.

- 122 t of *P. polyphagus* were landed at New Ferry Wharf, Mumbai, (showing 19% increase over the previous year) at a catch rate of 0.07 kg/h. Occurrence of females were maximum in September (52%) and the catch was maximum in October (37 t). Sex-ratio showed dominance of females in all the months.
- 470 t of crabs were landed at New Ferry Wharf and 143 t at Versova at a catch per hour of 0.3 and 0.2 kg, respectively and *C. feriatus* constituted 52% of the landing.
- The total landing of crabs at Mangalore-Malpe harbours was 586 t, with a catch rate of 0.3 kg/hr registering a 47% decrease in the landing and 50% decrease in the catch rate. *P. sanguinolentus* dominated the catch (45%). 38 t of deep sea lobsters, *Puerulus sewelli* & *Nephropsis stewarti* were landed with the former dominating (83%) the catch .
- At Puthiappa, Calicut 601 t of crabs were landed by trawlers with *P. sanguinolentus* (85%) dominating the fishery. 49% of female *P. sanguinolentus* were in immature stage and 13% in berried condition. 4.8 t of lobsters were landed by gill-nets with *P. homarus* dominating the fishery, at Thikkodi, Calicut at a catch rate of 1.7 kg/unit.
- 263 t of lobsters were landed at Sakthikulangara-Neendakara harbours, with the deep sea lobster *P. sewelli* dominating the catch. Maximum landing (151 t) was reported in March. Females predominated the catches with 37% in berried stage. A fishery, though small in magnitude (8 t) for *T. orientalis* was reported, for the first time, from Quilon. The size ranged from 101 mm to 220 mm (TL). 43% of the females were in maturing stage. Total landing of edible crabs by trawlers at Cochin was 270 t. *P. sanguinolentus* and *C.feriatus* dominated the catches. An interesting observation made was that mini-trawls landed *C. lucifera* (56-125 mm size group) from shallower waters. Males constituted 95% of the catch with all the females in immature stage.
- At Kayalpattinam in Tuticorin, 9 t of lobsters were landed by bottom-set gill-nets at a CPUE of 1 kg with *P. ornatus* dominating the fishery. Total length ranged from 120 mm to 450 mm with the modal size at 215-255 mm. Yet, no berried females were encountered. Fishermen have increased the mesh size of gill-nets from 85 to 130 mm, the length from 90 to 160 m and ventured up to 60 m depth. Prices went up to Rs.1200/- per kg for lobsters weighing above 1 kg.
- At Mandapam, 200 t of crabs were landed by trawl nets and 30 t by bottom-set gill-nets with an average CPUE of 7 and 8 kg, respectively. The fishery was supported exclusively by *P. pelagicus*. 30 t lobsters were landed by trawl nets at Chennai and 3 t by gill-nets along Kovalam-Pudupattinam stretch. *T. orientalis* dominated both the landings (93% and 63%, respectively) followed by *P. homarus*. 552 t of crabs were landed at Kasimedu, at a catch rate of 1.3 kg/h, with *P. sanguinolentus* dominating (54%) the catches.

Salient observations

- *Lobster landing in Gujarat declined from 1080 t in 2000 to 403 t, 217 t, 185 t and 252 t in 2001, '02, '03 and '04, respectively.*
- *The exploitation ratio of* P. polyphagus *at Mumbai was found to be 0.79 for males and 0.88 for females, warranting management measures.*
- C. lucifera, *landed in small quantities, is emerging as a new fishery at Cochin, Calicut and Kakinada.*

Landing of *Thenus orientalis* at Sakthikulangara, Kollam



Monthwise landing of *T. orientalis* at Sakthikulangara

- At Kakinada trawlers landed 418 t edible crabs, showing 27% increase over that of the previous year at a catch rate of 14.2 kg/unit. *P. sanguinolentus* dominated (72%) the landings with 58% females in berried stage during January-February. Gill nets landed 74 t crabs with *P. pelagicus* (78%) dominating the fishery. Good landing (10%) of *C.lucifera* was reported from this centre. *Podophthalmus vigil*, which is gaining importance as an edible species, constituted 6% of the catch.

PROJECT CODE	**CRU/CAP/04**
PROJECT TITLE	**Taxonomy of Important Crustaceans**
SCIENTISTS	**K. Asokakumaran Unnithan,** Josileen Jose, S. Lakshmi Pillai, A.P. Dineshbabu, Joe K. Kizhakudan and Miriam Paul
CENTRES	Visakhapatnam, Kakinada, Chennai, Cochin, Mangalore and Veraval

- A total of 5 species of shrimps namely *Parapenaeopsis cornuta* and *Parapenaeus fissurus from* Penaeidae, *Heterocarpoides levicarina* and *Parapandalus longicauda* from Pandalidae and *Pontocaris pennata* from Crangonidae were additionally located and reported from Chennai. Two species of shrimps, viz., *Trachypenaeus curvirostris* (Penaeidae) and *Solenocera choprai* (Solenoceridae) were also added to the species recorded from Mumbai.
- From Chennai, 7 species of crabs namely, *Portunus pubescens* (Portunidae), *Atergatis roseus* (Xanthidae), *Doclea ovis* and *D. canalifera* (Majidae), *Parilia major* and *Ixoides cornutus* (Leucosiidae) and *Carcinoplax verdensis* (Goneplacidae) were reported.
- One species of lobster, *Panulirus penicillatus* was reported from Chennai.
- One species of stomatopod, *Lysiosquilla tridecimentata* was reported from Chennai.

PROJECT CODE	**CRU/CUL/01**
PROJECT TITLE	**Broodstock Development, Selective Breeding and Restocking of Marine Shrimps**
SCIENTISTS	**K.R.Manmadhan Nair,** G.Maheswarudu, U. Rajkumar. E.V.Radhakrishnan, K.K.Philippose and V.S. Kakati
CENTRES	Mandapam Camp, Visakhapatnam, Cochin, Calicut and Karwar

- Breeding and larval rearing experiments using the green tiger shrimp *Penaeus semisulcatus* were carried out at Mandapam.
- 6.2 million nauplii from 82 spawners were obtained. 2.4 million postlarvae produced at an average survival rate of 47.8% were released in Gulf of Mannar.
- 43000 postlarvae were also produced from a rematured spawner. The larvae had a survival rate of 71.5%.
- Influence of Arachidonic acid in induction of maturation in *P. semisulcatus* females was studied. Arachiodonic acid was administered at doses of 10 µg, 25 µg and 50 µg/g bodyweight every fifth day. Prawns injected at a single dose of 25 µg/g matured and spawned after 13 days. In the control specimen ovary did not develop beyond stage 2.

- Experimental culture of the Oligocheate, *Pontodrilus bermudensis* was initiated at Visakhapatnam. In *P. semisulcatus*, earlier studies carried out at Mandapam showed fast ovarian maturation on feeding with this worm.
- Wooden crates seeded with 40 worms showed seven-fold increase in number (274 nos) after 80 days.

PROJECT CODE	**CRU/CUL/02**
PROJECT TITLE	**Breeding and Seed Production of Lobsters and Crabs**
SCIENTISTS	**E.V. Radhakrishnan,** Josileen Jose, Rekha Devi Chakraborty, K.R. Manmadhan Nair, V.S.Kakati and Joe K. Kizhakudan
CENTRES	Cochin, Chennai, Mandapam and Karwar

Cochin

- For the first time successful maturation and spawning of *Panulirus longipes* was achieved in captivity.
- An improved recirculation system for larval culture of phyllosoma larvae was fabricated and installed. Plastic beads used as filter substrate. Green water system found to be better than clear water system for culture of phyllosoma larvae.
- Two breeding experiments were conducted using wild breeders of the spiny lobster *Panulirus homarus*. While larvae fed on *Artemia* nauplii moulted to stage 2, those fed exclusively on mussel meat failed to moult. *Artemia* nauplii is the most suitable feed until larval stage 3. *Sagitta* sp., ctenophore medusae and 5-10 day old 'SELCO' enriched *Artemia* were accepted by late stage larvae.
- The first successful advanced larval development of *P. homarus* was achieved by adopting ecosystem culture method in which larvae metamorphosed to Stage VIII in 42 days compared to stage V in clear water system under similar conditions and feeding. Earlier, larvae attained stage VII in 60 days.
- A recirculating system for broodstock holding of marine crab was established in a 5 t tank. The filtered water was circulated at 48 l/ minute. 12 *Portunus pelagicus* adult crabs are being maintained and fed twice with fresh clam meat and will be used as broodstock for breeding experiments.

Recirculation system for culture of phyllosoma larvae

Chennai

- Complete larval rearing of *Thenus orientalis* can be achieved in 30-35 days using combination diet of fresh clam meat and zooplankton. The arrow-worm *Sagitta enflata* is preferred by phyllosomal stage I and stage II while the advanced phyllosomal stages (stages III and IV) show excellent response to the ctenophore *Pleurobrachia bachiae*.
- By rearing *T. orientalis* seeds in closed recirculatory systems with *in situ* fluidized substrate bed filters and reduced light intensity and using fresh clam meat as feed, the subadult size weighing approximately 35 g in weight can be obtained in about three to four months and in 180 days, the animals, attain an average weight of about 150 g (160-164 mm TL), which is the minimum legal size for export of *T. orientalis*.

Salient achievements

- *Feed and feeding schedules for larval rearing of the slipper lobster* Thenus orientalis *has been standardized.*
- *The arrow-worm* Sagitta enflata *for larval stages I and II and the ctenophore* Pleurobrachia bachiae *for stages III and IV are the most suitable live feeds.*
- Artemia *nauplii for larval stages 1 to 3 and enriched larger frozen* Artemia *for later stages found acceptable for culture of* P. homarus *larvae.*

- Puerulii of *P. homarus* have been grown in closed recirculatory rearing system using fresh clam meat and commercial shrimp pellets as feed. Growth progressed from 16-19 mm TL to 85-90 mm TL (average weight gain of 30-50 g) in 220 days, with a survival rate of 50%. Pellets ranging in diameter from 1.8 mm-2 mm were found to be better for smaller lobsters in terms of wastage and consumption while pellets of 2 mm and 2.2 mm size were better for bigger lobsters.
- Juvenile spiny lobsters transferred to black FRP tanks with no light exposure developed a dark green pigmentation, which is usually preferred in live lobster trade. Larger lobsters grown in other tanks with light exposure, upon shifting to black tanks with no light exposure developed dark pigmentation within two weeks. This technique can be used to darken the colour of live lobsters ready for harvesting after fattening.
- Unilateral eye ablation of mature female lobsters resulted in reduced growth rate and increased reproductive activity. The frequency of breeding is higher in these animals. Stunting in growth by other means of reduction in feed quantity and quality also results in increased reproductive capacity, but the fecundity and hatching are comparatively lower.

Mandapam

- 16 sets of experiments on breeding and seed production of *Portunus pelagicus* were carried out.
- 26 million zoea were produced and 25.7 million released into Gulf of Mannar. 4630 crablets were produced.

PROJECT CODE	**CRU/CUL/03**
PROJECT TITLE	**Organic Farming of *Penaeus semisulcatus***
SCIENTISTS	**K.R.Manmadhan Nair,** P. Vijayagopal and Bindu Sulochanan
CENTRES	Mandapam

- Three preliminary experiments were carried out following organic protocols for the seed production of *Penaeus semisulcatus*, larval rearing and live feed culture.
- Whereas spawning of wild caught prawns could be achieved without much problem, larval rearing posed serious problem due to delay or lack of development of diatom in the culture tanks.
- Experiments were conducted with concentrates/extracts of organic manures for mass culture of live feed. Lack of feed/nutrition and consequent weakening of the larvae rendered them vulnerable to the attack of pathogens and opportunistic predators.

MOLLUSCAN FISHERIES DIVISION

During 2004-05 period, the molluscan fisheries division implemented 7 in- house research projects of which 2 were on the molluscan resource characteristics, 4 on various mariculture aspects and one on biodiversity studies. Six externally funded projects were carried out during the period, 4 of them were completed and 2 are being continued. Funding for 2 projects was received from National Agricultural Technology Project, 1 from IFS, 1 from Department of Ocean Development and 2 from ICAR –AP Cess Fund.

PROJECT CODE	**MOL/CAP/01**
PROJECT TITLE	**Fishery and Biological Characteristics of Exploited Cephalopod Resources**
SCIENTISTS	**K.S. Mohamed,** R. Sarvesan, G.S. Rao, A.C.C. Victor, V. Kripa, P.K. Asokan, N. Ramachandran, S. Thomas, G. Sasikumar, M.K. Anil, B. Ignatius and V. Venkatesan
CENTRES	Mumbai, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

The all India production of cephalopods during 2004 was estimated as 1.13 lakh t which is 3.85 % less than the previous year and the landings along the west coast accounted for 82 % of the total production. Observations on the landings and biological characteristics of cephalopods from Veraval, Mumbai (New Ferry Warf), Mangalore (Mangalore, Malpe), Cochin (Munambam, Kochi, Vypin, Neendakara, and Sakthikulangara) and Vizhinjam on the west coast of India and Tuticorin, Mandapam (Mandapam, Pamban, and Rameswaram), Chennai and Visakhapatnam on the east coast were made. Trawlers contributed more than 90% of the cephalopod catch. *S. pharaonis* was landed at Vizhinjam in hook and lines operated from mechanized and non mechanized crafts and boat seines.

There was decrease in catch and catch rate at Mumbai, Mangalore, Malpe, whereas Kerala registered a 66% increase. Maximum increase in catch rate was observed in Cochin. This could be the positive result of awareness among the fishermen for conservation as well as the local resistance on the destruction of the spawning grounds by the Kolachel fishermen by keeping fish aggregation devices on trawling grounds.

Species composition

Sepia pharaonis was the dominant species caught along the west coast except at Veraval and Mumbai where it was *Sepia aculeata* which also dominated in the catches of Visakhapatnam and Tuticorin. Among squids *Loligo duvauceli* contributed the bulk along the west coast while *Sepioteuthis lessoniana* was the dominant species along the east coast. At Cochin, there was a remarkable decrease in the catch of *L. duvauceli* but *Doryteuthis singhalensis* showed an increasing trend and was caught in all the months.

Seasonal abundance

Seasonal abundance of cephalopods as indicated by catch rates are shown as primary and secondary peaks subsequently. Along the west coast peak season of abundance was post-monsoon except in Mumbai where it was pre-monsoon. In the east coast primary peaks were mostly pre-monsoon months and details are given below:

Centre	Period of abundance
Veraval	Sep., Oct-Nov
Mumbai	Feb, April-Oct
Mangalore	March, Sep.-Oct
Malpe	Sep.-Nov
Cochin	Aug, Sep.-Oct
Vizhinjam	Jan, Feb
Tuticorin	Aug-Oct
Mandapam	July-Nov
Rameswaram	Sep.-Oct, Dec.
Pamban	Jul, Aug
Visakhapatnam	Jul, Aug

Species composition of cephalopods landed at different centres in percentage

Group/ Species		Veraval	Mumbai	Mangalore	Malpe	Cochin	Tuticorin	Mandapam	Rameswaram	Pamban	Madras	Visakapatanam
Cuttlefishes	**Cuttle fishes**											
	Sepia pharaonis	13	16	31	40	57	26	26	24	25	36	30
	S.aculeate	57	27					24	25	26	10	44
	S.prashadi			1.6	1.6	1					7	3
	S.elliptica			9.5	9.4	1.4						3
	S.brevimana					1					8	
	S.trygonina			0.1	0.1	0.3						
	Sepiella inermis	4	12	0.5	0.6	2	21	8	7	7	7	12
	Total	74	55	43	51	63	47	58	56	58	68	92
Squids	**Squids**	26	40	52	46	14	26	5	5	8	10	8
	Loligo duvauceli										3	
	L.uyii					4.4						
	D.singhalensis			2.6	2	3					2.7	
	D.sibogae					0.1	27	19	20	17		
	Sepioteuthis lessoniana										0.6	
	Loliolus sp.											
	Total	26	40	54	48	22	53	24	25	25	16	8
Octopus	**Octopus**											
	Octopus defleni					0.2						
	O.membranaceous			3.2	0.8	10						
	O.dollfusi				4					10		
	O.lobensis					0.8						
	Octopus sp.		5.2	0.3	0.1			18	19	17		
	Cistopus indicus					0.1					6	
	Total		5	3	1	15		18	19	17	16	

Biology of Key Species

Loligo duvauceli: - At Mangalore size range in DML was 50-460 mm, larger modal lengths were observed during post-monsoon coinciding with peak breeding season. The annual mean length was 160 mm at Manglore-Malpe. At Rameswaram and Mandapam size ranged from 40-160 mm DML with mean sizes at 102 mm and at Visakhapatnam size range in DML was 40-309 mm.

Sepia pharaonis: - At Cochin, length range in the fishery ranged from 40-365 mm DML. Multiple modes were seen in all months. Peak recruitment to the fishery took place in March and in November-December indicating two peak breeding. In all other months, immature females were dominated in catches. However mature males were observed in all the months. At Mangalore size ranged from 70-410 mm DML. At Rameswaram-Mandapam size ranged from 90-360 mm DML with mean size at 175 mm and at Visakhapatnam size range in DML was 70-290 mm.

Doryteuthis sibogae: - At Cochin the size range was 60-310 mm DML and mature individuals dominated during March. Peak recruitment was observed in May.

D.singhalensis:- Size ranged from 60-370 mm DML. Mature females were observed in December indicating peak spawning.

Octopus membranaceous: - Length range WAS 36-95 mm and mature females were observed in March and October while mature males were dominant throughout the year.

Stock Dynamics

The annual total mortality rates of *L. duvauceli, S. pharaonis, D. sibogae* and *O. membranaceous* stocks exploited from Cochin were estimated with available growth parameters using the length converted catch curve. The total mortality rates increased in the case of *S. pharaonis* and *D. sibogae* and declined in the case of *O. membranaceous*. The exploitation rate of *L. duvauceli* showed a drastic decline from 0.72 in 2000 to 0.48 during 2002 and increased to 0.56 in 2004. The exploitation rate of *O. membranaceous* showed considerable increase up to 2002 and thereafter a decline. The values for *L. duvauceli* and *O. membranaceous* have been continuously declining from 2000 and 2002, respectively. On the other hand the Z value of *S.pharaonis* has been continuously increasing since 2002. At Mangalore, both squid and cuttlefish stocks were exploited above the optimum level and at Mandapam, *S.lessoniana* stocks were exploited above the optimum level.

Location	Species	Total Mortality Rate-Z	Natural Mortality -M	Fishing Mortality -F	E= F/Z
Mangalore	*L. duvauceli*	5.12	1.74	3.38	0.66
	S. pharaonis	4.18	1.6	2.58	0.62
Cochin	*L. duvauceli*	2.55	1.12	1.43	0.56
	S. pharaonis	3.01	1.25	1.75	0.58
	D. sibogae	5.85	2.51	3.34	0.57
	O. membranaceous	2.54	1.11	1.43	0.56
Tuticorin	*S. pharaonis*	2.85	1.85	1.0	0.46
	L. duvauceli	3.56	2.06	1.5	0.27
Mandapam	*S. pharaonis*	5.15	2.42	2.73	0.53
	S.aculeata	3.74	2.91	0.83	0.22
	Sepioteuthis lessoniana	7.86	2.75	5.11	0.65

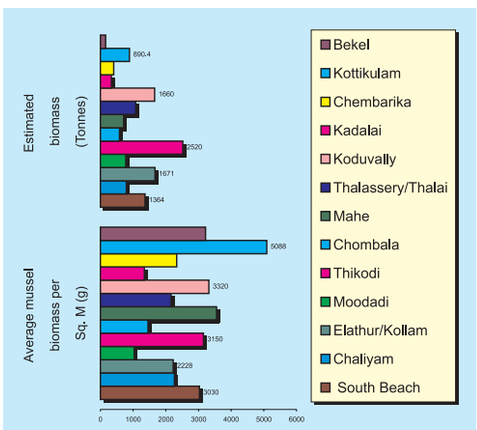
Sepia pharonis

Salient Achievements

- Increased production in all the centres of Kerala, maximum increase in CPUE (C/hr in kg 170%) was observed in Cochin.
- Diversification of species utilization may be the reason for the increased production of *Doryteuthis* sp and *Octopus* sp.
- The exploitation rate of *L. duvauceli* and *O. membranaceous* showed declining trend.
- The Z value of *S. pharaonis* has been continuously increasing since 2002 showing need for greater caution.
- After tsunami there was an increase in the landings of Palk Bay squid *S. lessoniana.*

PROJECT CODE	**MOL/CAP/02**
PROJECT TITLE	**Assessment of Bivalve and Gastropod Resources**
SCIENTISTS	**G. Syda Rao,** R. Sarvesan, P.V. Sreenivasan, A.C.C. Victor.,T.S. Velayudhan, V. Kripa, Shoji Joseph, Geetha Sasikumar, P. Laxmilatha, P. K. Asokan, Sujitha Thomas N. Ramachandran, M.K. Anil Boby Ignatius and V. Venkatesan
CENTRES	Karwar, Mangalore, Calicut, Kochi, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada, Visakhapatnam and Mumbai

During the period under report, landings of important groups of bivalves and gastropods comprising clams, edible oysters, mussels, sacred chanks, whelks and ornamental gastropods from 8 major centres viz. Karwar, Mangalore, Calicut, Kochi in west coast and Tuticorin, Mandapam, Chennai and Visakhapatnam in east coast were estimated. The total production was 63,283 t, of which 62935 t were bivalves. Landings of bivalves showed an increasing trend (22% increase) and clams as a single group contributed 50,970 t forming 81% of total bivalve production during this year. The clam *Villoritta cyprinoides* was the major species. Among the maritime states, Kerala contributed 86% of the total landings.



Mussel seed settlement along Malabar coast November 2004

Species	Karnataka	Kerala	Tamil Nadu	Andhra Pradesh	Total
Clams					
Villoritta cyprinoides	836	41259	0		42095
Paphia malabarica	516	1728	0		2244
Meretrix casta	1119	687	0	469	2275.5
Meretrix meretrix	179	0	0	118	297
Marcia opima	19	0	0		19
Sunetta scripta	0	4032	0		4032
Anadara granosa	0	0	0	8	8
Total	**2669**	**47706**	**0**	**595**	**50970**
Edible oysters					
Crassostrea madrasensis	107	36		393	536.5
Saccostrea cucullata	95	0			95
Total	**202**	**36**		**393**	**646**
Mussels					
Perna viridis	4077	6738	473		11288
Perna indica	0	31	0		31
Total	**4077**	**6769**	**473**		**11319**
Bivalve total	**6948**	**54511**	**488**	**988**	**62935**
Gastropods					
Xancus pyrum			239		**239**
Hemifusus pugilinus			70		**70**
Babylonia spp.			8		**8**
Ornamental gastropods			16		**16**
Total			**333**		**333**
Others			15		**15**
Grand total	**6948**	**54512**	**836**	**988**	**63283**

Karwar

The total bivalve landings were estimated at 763 t showing a decrease from that of the previous year (820 t); *Paphia malabarica* was the dominant species followed by *C. madrasensis* and *Saccostrea cucculata.*

Mangalore

The clam landings from Mulki were estimated at 863 t showed 35% increase. *M. casta* contributed 63% followed by *Paphia malabarica*, *Villorita cyprinoides* and *Meretrix meretrix.* Mussel landings from Someswara-Jali area were estimated at 3905 t, and it showed a 68% increase as compared to previous year. The craft used for mussel fishing were floats or "pathi" and canoes.

Calicut

The total mussel landings in the Malabar Coast from 8 major centers were 6738 t showing 28% decline in comparison to 2003. This year a very good natural settlement of mussel spat occurred along Malabar Coast. The estimated total biomass along Malabar Coast was 4,400 t, total settlement area was 58 lakh sq.m and the length range of mussel seed was 4-28 mm.

Kochi

The reappearance of *M.casta* at Chettuva resulted in heavy landings. Clam fishery started only in March 2005 and 67.5t of clams having the length range of 13.1 -20.03 were landed within one month.

A total of 161 t of *V.cyprinoides* and 67.5 t *M.casta* (Chettuva estuary), 1653 t *P.malabarica* and 36.5 t *C.madrasensis* (Ashtamudi Lake), 41003 t of *V.cyprinoides* (Vembanadu Lake) and 4032 t *S.scripta* (Vypin Island) were landed.

Tuticorin

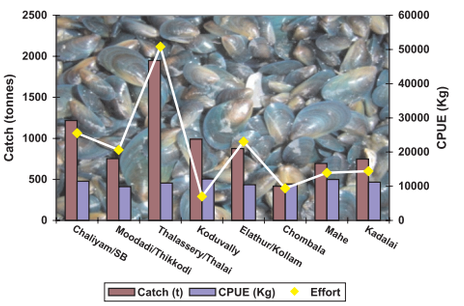
A total of 95,970 chanks (Jadhi variety) were landed at two landing centres viz; Kayalpattnam and Tharuvaikulam. The depth of fishing area was 20-25 m. Higher MSD (Maximum Shell Depth) 53-138 mm with a CPUE of 23 Kg was recorded in Kayalpattnam. The Gear used was 'podivalai' (bottom set gill net with mesh size of 85 mm).

Mandapam

Total number of chanks landed was highest at Rameswaram (133,649 nos) compared to Mandapam (57,525 nos). The overall length, ranged from 80-240 mm with an MSD (Maximum Shell Depth) of 40-130mm. The length –weight relationship of *X. pyrum* var. *acuta* (Jadhi variety) is derived as Y = 3.48 X – 209.63, where as for var. *pyrum* is Y = 3.8181x –219.02.

A total of 2.8 lakhs of *Hemifusus pugilinus* in the length range of 50-150 mm with CPUE of 4.37 was also landed at Rameswaram landing centre.

After Tsunami, bumper catch of *Xancus pyrum* was reported from Nagapattinam.



Perna viridis Production along Malabar coast 2004

Villorita cyprinoides landing at Muhamma

Meretrix casta landing at Chettuva

A bumber catch of sacred chank at Nagapattinam

The chanks landed at Nagapattinam, after tsunami had a length range of 203-269 mm, MSD 105-160 mm with a weight of 1.6 to 2 kg and they were caught at 60-80 m depth. 3000 numbers of these chanks were brought to Rameswaram for sales. The shells were semi - fossilized without much damage. The normal average weight of chanks collected of the same size from Rameswaram is usually 900 g

Standing stock of edible oyster and clam was estimated from Athankarai estuary and three oyster beds were identified. One bed had 41 clusters located at a distance of 0.72 km from the mouth of the estuary spreading over a distance of 200 m along its western bank. The total area was 1,367 sq.m with an average density of 164/sq.m and estimated total number of oysters present in the bed was 2, 24,162. Second bed with 51 clusters were located 10 m away from the eastern bank. Estimated total area of the bed was 13,693 sq.m with an average density of 129/sq.m.and total number was 17, 66,376. The third was the smallest among the three, consisting of 11 clusters located along the northern bank of estuary at a distance of 2.94 km. Total area was 562 sq.m with an average density of 129sq.m and estimated total number was 72,526. The clam bed (*Meretrix casta*) was located at a distance of 3.2 km away from the mouth of the estuary. Average density of clam was 800 nos/sq.m, the density decreased as the depth increased corresponding to the nature of the substratum.

Chennai

Commercially important edible and ornamental gastropods (29.8 t) were landed at Chennai FH, showed a marginal increase from that of the previous year. Among the 16 spp. of gastropods landed *Babylonia spirata and B. zeylanica* were the major species. Biological studies on *Babylonia* reveals that its breeding season extends from December to April. Percentage of male was higher in March and female in April. Length range of mature specimens were 40.8-47.2 mm.

Visakhapatnam

The bivalve landings from Bhimili estuary were 987 t, clams formed 64%. Landings (13%) as well as effort (14,644 man-days) showed an increase. Major catch was recorded during April and lowest in December.

Salient achievements

- The All India bivalve production was estimated as 62,936 t as against 48,792 t of 2003 showing an increase of 22%.
- Among the bivalves *Villoritta cyprinoides*, *Perna viridis* and *Sunetta scripta* contributed the major share.
- The total gastropod production was estimated as 333 t. *Xancus pyrum* and *Hemifusus pugilinus* contributed the bulk of the landings. Due to tsunami large quantities of semi - fossilized large *Xancus pyrum* were landed at Nagapatinam.

PROJECT CODE	**MF/CUL/01**
PROJECT TITLE	**Technological Feasibility Studies and Up-gradation of Molluscan Mariculture**
SCIENTISTS	**K.K.Appukuttan,** A.C.C. Victor, V. Kripa, R. Sarvesan, P.V. Sreenivasan, G. Syda Rao, P. Muthiah T. S. Velayudhan, K.S. Mohamed, Geetha Sasikumar, P. Laxmilatha, P.K. Ashokan, Sujitha Thomas, I. Jagadis and V. Venkatesan
CENTRES	Mangalore, Calicut, Kochi, Tuticorin, Mandapam, Chennai, Kakinada, and Vishakhapatnam

Visakhapatnam

6-8mm pearls were produced (*P.fucata*) by using on-shore pearl culture technology. The re - use of nucleated pearl oysters found successful. *P.maxima* spat grown in captivity reached adult stage. *P.margaritifera* and *P.chemnitzii* collected from around Visakhapatnam are growing very

well under onshore conditions.

Chennai

Mussel culture was initiated in the feeder canals of prawn farm in Pulicat lake. Rack of 10 x 10 m size was used to suspended 98 seeded ropes of 1.5m length. A total of 490 kg seed were used and harvest was done in September 2004, giving a production of 1800 kg of mussel. The present experiment was the first of its kind for green mussel cultured in Pulicat area.

Tuticorin

428 nos of pearl oyster (*P.fucata*) were nucleated with 4mm bead nuclei.Clam (*P.malabarica*) culture experiments were carried out to find out the ideal stocking density of seed clams while doing relaying. *P.malabarica* seed of 3.3 mm were reared in densities of 200, 300 and 400/m^2 in the hatchery. Maximum growth rate of 2.4 mm/month was observed for the seed reared in 400/m^2.

Mandapam

Various types of spat settlers like lime coated coconut halves, tiles, corrugated asbestos sheet and bunch of nylon threads were placed in the oyster beds of Athankarai estuary to study the pattern of spat settlement. But the Tsunami resulted in loss of settlers.

Vizhinjam

Production of quality image pearl of 6-8mm in *P.sugillata* was achieved in captivity.

Kochi

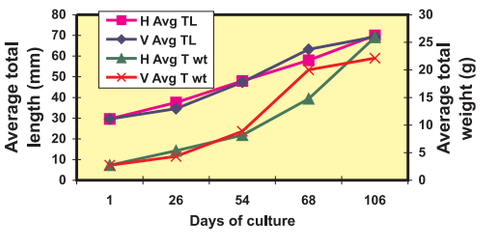
Eight women SHG's at Kayamkulam have taken up edible oyster farming. 8 oyster demonstration farms and 2 mussel farms were established at Ashtamudi estuary and two oyster farms were setup in Sathar Island. More than 20 oyster farms were setup at Sattar island by women SHG's with the financial aid of BFFDA. Seventeen farms were washed away by Tsunami. Edible oyster production was estimated at 2.2 t at S.Island and for Green mussel it was estimated as 2 t at Chettuva.

At Kollam, field performance of mechanically seeded ropes was compared with that of manually seeded ropes and it showed a reduction in slippage and seeding time.

Kozhikode

The mussel seeder developed during the previous year was demonstrated to nearly 650 musssel farmers in Malappuram, Kozhikode and Kasaragod districts of north Kerala. A submerged raft was released in Korapuzha estuary to reduce biodeposition problem.

The white clam *M. casta* was cultured in netlon cages in two different methods viz; bottom and suspended, at three stocking densities. Seed clams of average total length 15 mm and average total weight 1.25 g collected from the natural clam beds in the Moorad estuary were used for the experiment and grown for a period of five months. In bottom culture, the clams attained an average length of 28.3 mm (800 no/m^2), 28.05mm (1200no./ m^2) and 27.17mm (1600no./ m^2) in four months.



Growth of horizontally (H) & vertically (V) grown mussels: Karuvanthurithy, Chaliyar January to May 2005

Cultchless spat produced at Kozhikode

Demo mussel farm at Karuvanthuruthy, Kozhikode with active participation of local fisherfolk

Mussel fattening. In Malappuram district, some mussel fishers are adopting a semi fattening method of mussels. During January- March when the mussels fished from the natural beds are below 60 mm size, the fishers stock the mussels fished in the estuarine regions for further growth. These are harvested after 40 to 60 days.

An integrated bivalve (oyster & mussel) research cum demonstration farm of 90 m^2 area was set up at Karuvanthuruthy in Chaliyar estuary. Comparative studies of growth, production and meat weight for vertically suspended rope and horizontally suspended ropes were done. The vertically suspended mussels registered better growth in terms of length, weight and meat weight.

A simple method of producing cultchless spat of edible oyster *Crassostrea madrasensis* (Preston) has been developed. The clam shells (*Meritrix casta*) served as very good cultch for the edible oyster spat and profuse spat settlement occurred on these shells. Spats after three weeks of growth were cultchless.

Mangalore

A demonstration farm of 3x3m rack was set up in Udayavara estuary in Malpe. A total of 45 seeded mussel ropes were suspended from the rack. Another ten seeded ropes bring it from Someshwara were also put on to the rack to compare the growth of the seeds from different locations. All farm structures were destroyed by Tsunami.

Goa & Karwar

Two groups of farmers from Goa and 3 groups from Karwar have taken up mussel farming.

Salient achievements

- Demonstrated and popularized the mussel seeder among mussel farmers of Kasargod and Calicut.
- Developed mussel declumping machine.
- Production of farmed green mussel touched 4500 t mark.
- Edible oyster production of this year was 800 t.
- Demonstration of integrated mussel farming initiated.
- More mussel culture demonstration farms were set up in south west and east coast of India.
- Clam culture experiments in *M. casta* were initiated at Kozhikode.
- Developed technology for producing cultchless spat of edible oyster at Kozhikode.

PROJECT CODE	**MOL/CUL/02**
PROJECT TITLE	**Selective Breeding of Pearl Oyster *Pinctada fucata* (Gould)**
SCIENTISTS	**T. S. Velayudhan,** P. C. Thomas, P. Muthiah, G. Syda Rao, N. Ramachandran, S. Dharmaraj, V.Kripa, Shoji Joseph, Boby Ignatius, U. Rajkumar and C.P. Tayade
CENTRES	Kochi, Vizhinjam, Tuticorin, Mandapam and Vishakhapatnam

Twenty nine spat and five adult pearl oysters transported from Gujarat to Thankassery Bay and Tuticorin survived only for four months, while *P. fucata* adult and spat from Tuticorin survived well in Gujarat.

The pearl oyster spat transplanted from Tuticorin to Thankassery Bay for selective breeding studies showed good growth. Nucleus of 8-10 mm was used in 23 oysters of 65-75mm in DVM range of which only three survived during convalescence. Those oysters were transplanted to Thankassery farm but died due to unexpected blooming of toxic algae in the farm area.

The hatchery produced spat at Mandapam was segregated into fast, medium and slow growing based on their growth and observed growth in captivity and farms.

A total of 23,800 spat from S1 generation of *P.fucata* with larger depth were reared in Tuticorin and comparative studies were done on the spat from lesser depth parents. Those spat with higher shell cavity had 1.5 mm (depth) and spat from lesser shell cavity parents had a depth of 0.99 mm with in two months.

Improved implantation technique was tried using the specially designed instruments for nucleation of larger nucleus at CMFRI was further tested successfully in *P. margaritifera, Pteria penguin* in Andamans and *P.fucata* in Kollam and Vizhinjam.

Salient achievements

- Experiments on segregation of pearl oyster with large body cavity were continued.
- Segregated oysters were nucleated with 8-10 mm nuclei. Specially designed instrument successfully tested in *P.margaritifera* and *Pteria penguin* in Andamans.

SO Parents with larger depth (Thickness) from Vizhinjam

PROJECT CODE	**MOL/CUL/03**
PROJECT TITLE	**Technological Up- gradation of Molluscan Seed Production**
SCIENTISTS	**P. Muthiah,** P. Laxmilatha, S. Dharmaraj, P.K. Asokan, Boby Ignatius and M.K. Anil
CENTRES	Calicut, Vizhinjam, Tuticorin and Mandapam

Tuticorin

- At Tuticorin, spat production of pearl oyster, edible oyster and clams was continued. Five thousand one hundred pearl oysters spat (1 to 1.5 mm) were supplied to Chennai Research Centre and four hundred numbers to Vizhinjam and Kollam.

Adult edible oyster were maintained as broodstock which gave 12 spawning. Settlement percentage ranged from 0.014 to 2.02 %. Out of 255 strings made with the spat set on shells in the hatchery, 150 were transferred to the farm and the rest are being maintained in the hatchery.

New batch of *P. malabarica* collected from Kollam did not give any spawning but the seed produced from a spawning in December '03 attained an average size of 13.8 mm.

- 17th generation of *S. inermis* maintained at Tuticorin hatchery laid eggs but did not attain maturity. An egg cluster of *S. pharaonis* maintained in the hatchery released 144 hatchlings which were reared upto 21st day. Feeding experiments for *S. pharaonis* juveniles showed that those fed with 20% of feed (mysid) at the ratio of its body weight gave a growth rate of 4.6 mm ML with a weight of 2.1 g/month.

In the salinity tolerance experiment, the juveniles reared in 35 ppt had shown good growth rate of 9.5 mm ML with 1.1 g than those reared in 25 and 30 ppt.

Mandapam

- 35 nos. of *Xancus pyrum* were reared in the hatchery. Growth and feeding experiments for baby chanks are being continued.

Vizhinjam

- Egg masses of squid *D. singhalensis* collected in September hatched in laboratory conditions and the young ones survived for only one month. Two batches of *S. lessoniana* were reared in the hatchery for developing broodstock with trial feeding experiments on food preference using zooplankton.

Kozhikode

- At Kozhikode, induced spawning trials in *M. violacea* were carried out using brood stock collected from Calicut and Thalai. These were subjected to thermal stimulation (29 -33^0 C) in eight experiments, but no spawning occurred.

PROJECT CODE	**MOL/CUL/04**
PROJECT TITLE	**Marine Pearl Production through Tissue Culture**
SCIENTISTS	**S. Dharmaraj,** P. Muthiah,. K.C.George and P.K. Asokan
CENTRES	Tuticorin

Organ cultures were continued with mantle tissue of pearl oyster and abalone. Nacre coating was found to continue several months in *in-vitro*. Successful coating in all the beads tested. Intermediate feeding was arranged to cultures in order to accelerate nacre growth. Cell yield was found to increase towards higher concentration of calcium. Injection of free cells in live pearl oyster was also attempted. Results would be known after harvest. Organ cultures were organized using mantle tissue of windowpane oyster.

Salient achievements

- Nacre coating *in vitro* continued for several months
- Cell yield was found to increase with high calcium concentration

PROJECT CODE	**MOL/BIOD/01**
PROJECT TITLE	**Biodiversity of Marine Molluscs**
SCIENTISTS	**Shoji Joseph,** K. K. Appukuttan, R. Sarvesan, P.V. Sreenivasan, P. Muthiah, T. S. Velayudhan, V. Kripa, P. Laxmilatha, I. Jagadis and Sujitha Thomas
CENTRES	Cochin, Calicut, Chennai, Tuticorin and Mandapam

- Lists of molluscs recorded from Indian waters were documented group wise and species wise for the preparation of checklists. The checklist so far contains a total of 540 species of Gastropods from 240 families and 302 genera; 318 species of Bivalves from 90 families and 123 genera: 13 species of Polyplacophores from 8 families: 11 species of Scaphopoda from 7 families: 9 species of Aplacophores from 6 families and 201 species of Cephalopods from 26 families.
- Rare specimens of conus shells collected from the Indian coasts belonging to the family Conidae are *C. bengalensis, C. milne-edwardsi, C. generalis, C. geographus* and *C. nobilis.* Rare cowries belonging to the family Cypridae are *C. tigris, C. mappa,* and *C. lamacina*. Other rare and uncommon shells collected are *Cassis cornuata, Cypraecassis rufa, Fasciolaria trapezium, Lambis chragra, L. crocae, L. millepeda and L. truncata*. Apart from these, shells like

Trochus niloticus, Placenta placenta and *Strombus plicatus sibbaldi* were also included in the shells collected from the Indian coasts.

S No.	Family	No. Species (genera) identified	Areas of Collection	Exploitation rate
1	Trochidae #	3 (1)	Kl & Md	***
2	Neritidae	1(1)	Kl & Md	**
3	Architectonidae	2(1)	Kl	**
4	Cypridae	3(1)	Kl & Md	***
5	Strombidae #	6(2)	Kl & Md	***
6	Tonnidae	2(1)	Kl & Md	**
7	Ficidae	2(1)	Kl & Md	**
8	Bursidae	4(2)	Kl & Md	**
9	Cymatidae#	2(1)	Kl & Ko	**
10	Naticidae	5(2)	Kl & Md	**
11	Cerithidae	1(1)	Kl & Md	**
12	Xenophoridae	1(1)	Kl & Ko	*
13	Turritellidae	2(1)	Kl & Md	**
14	Littorinidae	1(1)	Kl & Md	**
15	Muricidae	6(2)	Kl & Md	***
16	Conidae#	19(1)	Kl & Ko	***
17	Turridae	3(1)	Kl & Ko	***
18	Buccinidae	2(1)	Kl& Ko	**
19	Fasciolaridae#	5(2)	Kl & Ko	***
20	Volutidae#	4(2)	Kl& Ko	***
21	Olividae	4(2)	Kl & Ko	***
22	Turbinellidae	1(1)	Kl & ko	***
23	Volemidae	1(1)	Kl & Md	**
24	Mitridae	2(1)	Md	**
25	Epitoniidae	1(1)	Kl & Md	*
26	Terebridae	2(1)	Md	*
27	Nassariidae	4(2)	Kl & Md	**
28	Columellidae	2(1)	Kl & Ko	***
29	Harpidae	1(1)	Kl & Ko	**
30	Marginellidae	1(1)	Kl & Md	***
31	Bullidae	1(1)	Kl & Md	***
32	Siphonariidae	1(1)	Kl & Ko	***

KI- Kollam Ko- Kochi Md- Mandapam; * Under exploited, ** moderately exploited, *** heavily exploited, # Includes endangered species

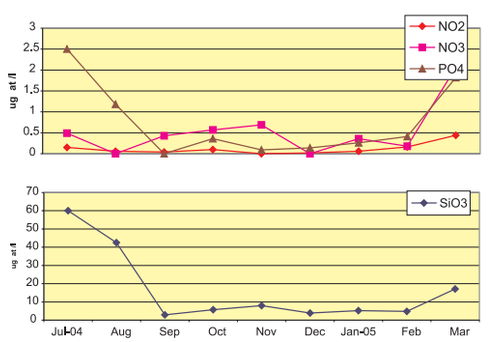
FISHERY ENVIRONMENT MANAGEMENT DIVISION

During the period under report, FEMD pursued research through 7 Inhouse projects and 4 funded projects. In addition to this, 8 consultancy programmes related to environment were also implemented. The scientists of the Division were also actively involved in the M. F. Sc and Ph. D programmes of PGPM. Eight students were awarded Ph.D degree under the guidance and research supervision of the Scientists of this Division.

Assessed the impact of effluent discharge from anthropogenic activities along the coastal waters and monitored the levels of heavy metals in water, sediment and biota along the coastal waters of India. Dry biomass of *Sargassum wightii* was found as an excellent biosorbent capable of removing cadmium and lead in the range of 50 - 97 % from a multi metal ion solution within 4 hours. 1200 juveniles of *Holothuria scabra* bred in Tuticorin hatchery of CMFRI were successfully sea ranched.

Training programmes were conducted on phytoplankton identification in June 2004 at Cochin, on post harvest and value addition techniques in seaweeds in September 2004 at Mandapam Camp and on seaweed cultivation and post harvest technology in March 2005 at Mandapam Camp. Organised a National Seminar on 'Untapped potential seaweed resources of Tamil Nadu and scope for gainful employment of self-help women groups of coastal poor in seaweed farming' in February 2005 in collaboration with Aquaculture Foundation of India, Chennai and CSMCRI, Bhavnagar at Mandapam Camp.

PROJECT CODE	**FEM/01**
PROJECT TITLE	**Monitoring the Environmental Characteristics of the Inshore Waters in Relation to Fisheries**
SCIENTISTS	**C.P. Gopinathan,** V. Chandrika, T.S. Naomi, Gulshad Mohammed, P.K. Krishnakumar, S. Jasmine, V.V. Singh, P.S. Asha, Rani Mary George, Bindu Sulochanan and K. Vijayakumaran
CENTRES	Cochin, Calicut, Mangalore, Karwar, Mumbai, Minicoy, Veraval, Mandapam, Tuticorin, Chennai and Visakhapatnam

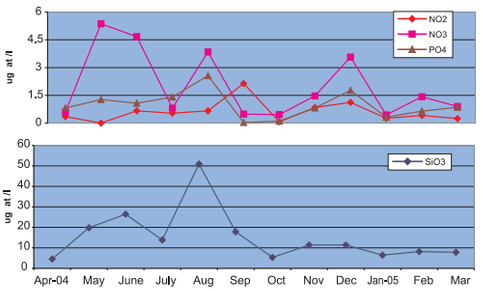


Nutrient values off Cochin (surface)

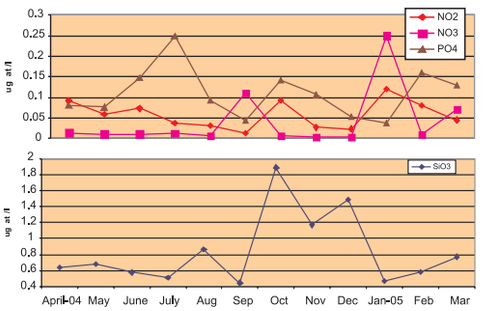
- The water temperature of the inshore waters ranged from 26.7 to 32.5°C in the west coast and it was 26.0 to 32.4 °C in the east coast. Values of salinity ranged from 10.5 ppt to 36.0 ppt in the west while it was 27.7 to 38.0 ppt in the east. The dissolved oxygen content ranged from 1.8 to 5.2 ml/l in the west and it was 1.16 to 6.5 ml/l in the east.
- Values of nitrite ranged from 0.18 to 2.14 µg at/l in the west while it was 0.02 to 1.4 µg at/l in the east. The nitrate values ranged from 0.66 to 5.37 µg at/l in the west while it was 0.09 to 1.3 µg at/l in the east. The phosphate values ranged from 0.04 to 5.20 µg at/l in the west while it was 0.09 to 1.3 µg at/l in the east. The values of silicate ranged from 1.8 to 60 µg at/l in the west and it was 0.02 to 6.64 µg at/l in the east.
- The gross primary production ranged from 28.0 to 715 mgC/m^3/day in the west and it was 24 to 1162 mgC/m^3/day in the east. The biomass of zooplankton recorded high values of 40.3 ml/100m^3 of water in the west and it was 8.0 ml/100m^3 of water in the east coast.

Salient findings

- *Blooming of toxic/ harmful phytoplankton organisms were observed in the coastal waters of Kerala during September-October period. At Calicut, blooming of* Hornellia marina *was noticed during September 2004. However, fish mortality was not recorded this year compared to the heavy mortality recorded in 2003.*
- *Blooming of the dinoflagellate,* Cochlodinium *sp. observed during August in the coastal waters of Quilon and* Goniaulax diegensis *in the coastal areas of Vizhinjam, caused harmful effects to the fauna.*
- *Public awareness on safe consumption of fishes brought to light by the detailed investigations carried out by the FEMD.*



Nutrient values off Mangalore (surface)



Nutrient values off Visakhapatnam

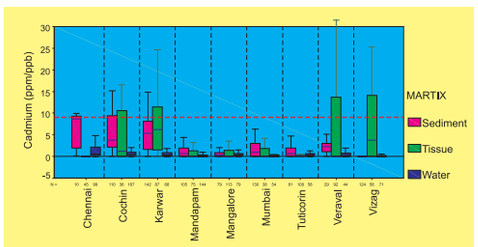
PROJECT CODE **FEM/02**

PROJECT TITLE **Monitoring Environmental Contaminants from Coastal Waters with Reference to Bioaccumulation and Biomagnification in Fishes**

SCIENTISTS **P.K. Krishnakumar,** George. J.P., P. Kaladharan, D. Prema, V.V. Singh, Rani Mary George, S. Jasmin, P.S. Asha, Bindu Sulochanan and K. Vijayakumaran

CENTRES Mangalore, Cochin, Mumbai, Karwar, Tuticorin, Mandapam and Visakhapatnam

- Concentrations of highly toxic metal, Cd in seawater samples from industrialized areas of Mumbai and Veraval were relatively high. Mean cadmium concentrations in sediment samples from the industrialized areas of Visakhapatnam, Cochin, Chennai, Karwar, Veraval and Mumbai were above the Effect Range Low (ERL) concentration of 1.2 ppm and below the Effect Range Medium (ERM) concentration of 9.6 ppm prescribed by NOAA for cadmium in sediment samples. Mean Cd concentrations (ppm dry weight) in fish sample from Cochin and Chennai were relatively high.
- Concentrations of Pb in seawater samples from industrialized areas of Chennai and Veraval were relatively high. Mean lead concentrations in sediment samples from the industrialized areas of Veraval and Mumbai were above the ERL concentration of 47 ppm. Mean Pb concentrations in fish samples from Tuticorin, Veraval and Cochin were relatively high.
- Concentrations of Cu in seawater samples from industrialized areas of Veraval, Tuticorin, Chennai and Mumbai were relatively high. Mean Cu concentrations in sediment samples from industrialized areas of Mumbai, Veraval and Karwar were above the ERL concentration of 34 ppm. Mean Cu concentrations in fish samples from Mumbai were relatively high.
- Mean Ni concentrations in sediment samples from industrialized areas



Cadmium concentrations in seawater, sediment and fish tissue samples collected from various centres

Salient findings

Generally, concentrations of toxic metals such as Cd, Pb, Cu and Ni in seawater, sediment and biota (shellfishes & finfishes) collected from the industrialized areas of Veraval, Mumbai, Cochin, Chennai and Karwar were high compared to the samples collected from relatively clean areas.

Collection of water samples off Mangalore coast

of Cochin and Mumbai were above the ERL concentration of 21 ppm. Mean Ni concentrations in fish samples from Mumbai and Veraval were relatively high.

PROJECT CODE	**FEM/03**
PROJECT TITLE	**Culture of Seaweeds**
SCIENTISTS	**N.Kaliaperumal,** P.Kaladharan, Reeta Jayasankar and Gulshad Mohammed
CENTRES	Mandapam, Cochin, Calicut

- Total landings of seaweeds in Tamil Nadu were 1668 t (dry weight) compared to 2749 t (dry weight) during 2004 constituting 995 t of *Sargassum* spp, 34 t of *Turbinaria* spp, 170 t of *Gelidiella acerosa*, 58 t of *Hypnea* spp, 76 t of *Gracilaria edulis*, 35 t of *G. crassa* and 300 t of *Gracilaria* spp.
- Pilot scale field cultivation of carrageenan yielding red seaweed *Kappaphycus alvarezii* carried out in the nearshore area of Palk Bay and Gulf of Mannar showed maximum increase in yield of 4.3 fold after 30-32 days in Palk Bay and 5.7 fold after 22-34 days in Gulf of Mannar. A total quantity of 12.5 t (wet wt) of crop was harvested during July 2004 to March 2005.
- The agar yielding red seaweed *Gracilaria salicornia* brought from Kottaipattinam (Palk Bay) was cultivated along with *K. alvarezii.* Five-fold increase in yield was obtained after 32 days of culture period.
- Experimental culture of *K. alvarezii* was carried out in onshore condition in 1t capacity fibreglass tanks with running seawater and aeration system. Maximum increase in biomass of 41% and 69% were obtained in the tanks introduced with 1000 g and 500 g seed material, respectively after 40 days of culture period. In the experiments conducted by pretreating the seed material for 12 hours at different concentrations of Diammonium phosphate, maximum increase in biomass of 180% after 48 days of culture period was recorded in the plants treated with 10-mg/l concentration.

Bamboo raft with grown up crop of *Kappaphycus alvarezii*

- Culture of *Kappaphycus alvarezii* was carried out in the subtidal area of Thikkodi for the first time during post-monsoon period. A record yield of 30-fold increase after 63 days and 34 fold after 86 days was obtained.
- Experiments conducted with *K.alvarezii* showed that this species could tolerate salinity upto 20 ppt for 45 days.
- Culture of agarophyte *Gracilaria corticata* was carried out at Narichal (Elathur) and Thikkodi using long line coir ropes during post-monsoon

period. Four-fold increase in yield was obtained at Narichal after 60 days of culture period.

- Polyculture of agar yielding red seaweed *Gracilaria verrucosa* and shrimp *Penaeus monodon* was carried out in a pond at Narakkal. Totally 870 kg of *G.verrucosa* was harvested from 2.7 kg of seed material introduced during 160 days of culture period. The agar yield from harvested crop ranged from 8 to 17.6%. Experimental farming of *Kappaphycus alvarezii* was carried out in the nearshore area of the sea at Narakkal. Crop with growth rate of 16 g/day was recorded within 40 days of culture period. 2.5 kg seed material yielded 21 kg crop.
- Polyculture of *K.alvarezii* and green mussel *Perna viridis* was carried out at Thangaserry Bay (Quilon) using floating bamboo rafts. Ten-fold increase in yield was obtained after 50 days of culture period. Culture of *K. alvarezii* was carried out in the backwaters (salinity 18-22 ppt) of Dalavapuram (Quilon), 4.5-fold increase in yield was obtained after 45 days of culture period.

PROJECT CODE	**FEM/04**
PROJECT TITLE	**Development of Strategies for Sea Turtle and Sea Cucumber Conservation**
SCIENTISTS	**M. Rajagopalan,** K. Vijayakumaran and P.S. Asha
CENTRES	Cochin, Visakhapatnam, Tuticorin

- The monitoring of the phenomena of the mass nesting of Olive Ridley *Lepidochelys olivacea* along the Orissa coast revealed the nesting of 2.7 lakhs of Olive Ridley during the 2004 season when compared to the nesting of 70,000 during 2003 season. Ten thousand Olive Ridley were washed ashore during the 2004 season along the Orissa Coast due to mortality in fishing gear.
- During April-July 2004, seven experiments on induced spawning trials were conducted in *Holothuria scabra* and on only one occasion, four males spawned. In view of the spent gonadal stage of the existing broodstock, 19 fresh brood stock specimens were collected from Kalavasal area, Tuticorin.
- With the fresh brood stock of *H. scabra*, spawning trials attempted during Oct-Dec 2004 raising the salinity level. The larvae of *H. scabra*, reared at a density of 1.65 lakhs per 500 litres of 35 ppt sea water, on 10th day became the doliolaria, on 15th day metamorphosed to pentactula and on 25th day became 1 mm size juveniles and survival rate of 8% was obtained. Sea ranched 1200 young ones of *H. scabra* of the mean size 25 mm in the sea grass bed at Tuticorin, in March 2005.

Olive ridley mass nesting - Orissa coast

PROJECT CODE	**FEM/05**
PROJECT TITLE	**Mariculture of Live Feed Organisms**
SCIENTISTS	**Rani Mary George,** Reeta Jayasankar, Molly Varghese and Gulshad Mohammed
CENTRES	Cochin, Mandapam and Calicut

- Mass culture of *Isochrysis, Chaetoceros, Chlorella and Nannochloropsis* was also carried out in order to feed the larvae of fish and invertebrates in the hatcheries.

- The marine micro-algal cysts of *Nannochloropsis* sp. cryopreserved at a low temperature of -15 to 20° C was tested and found viable up to one year.
- Evaluation of carotenoid content in *Dunaliella salina* cultured *at* 15°C, 25°C and 35°C temperature showed that 25°C was found to be most suitable for the yield of total carotenoid.
- Cultures of microalgae were sold to different hatcheries for Rs.31, 920 and Rs. 64,900 from Tuticorin and Kochi, respectively and the amount was deposited to ATIC of the Institute.
- At Kochi experiments on five strains of *Brachionus rotundiformis* and *B. angularis* were conducted to study the growth and multiplication of these rotifers in relation to feed consumption and physico-chemical characteristics. Experiments conducted to understand the reproductive potential of *B. rotundiformis* using 3 types of algae and baker's yeast revealed that the highest reproductive potential was recorded when fed with *Nannochloropsis* sp. Large-scale production of rotifer cysts through environmental manipulation was achieved at Mandapam.
- At Calicut different live feeds were given to the first time bred Boxer shrimp (*Stenopus hispidus)* from early larval to late post larval stages and the larvae survived for 50 days. Marine phytoplankters were fed from first day onwards in different combinations, rotifers from 15th day onwards upto 34th day and *Artemia* nauplii from 35th day onwards.
- Experiments to increase the survival rate of *Penaeus monodon* larvae from protozoea to postlarvae I by feeding photosynthetic sulfur bacteria along with *Tetraselmis* sp. in the ratio of 1:10 respectively have been attempted.
- Collection, identification and selection of candidate species were carried out; the effects of several food items (*Artemia* nauplii, rotifers and *Nannochloropsis* + rotifer) on larval production, survival and growth of the Mysid, *Eurobowmanilla simulans* revealed that this species had the highest production and survival rates when fed with *Artemia* nauplii.

PROJECT CODE	**FEM/06**
PROJECT TITLE	**Taxonomy of Marine Zooplankton**
SCIENTISTS	**T.S. Naomi,** Rani Mary George and S. Jasmine
CENTRES	Cochin and Karwar

The study brought to light the presence of all the seven world species of the genus *Lucifer* in the Indian EEZ and thus added **three more new records**, namely, ***L. chacei*** Bowman, 1967; ***L. intermedius*** Hansen, 1919 and ***L. orientalis*** Hansen, 1919 to the already known four species from India, *viz*., ***L. typus*** H.Milne Edwards, 1837; ***L. hanseni*** Nobili, 1905; ***L. penicillifer*** Hansen, 1919 and ***L. faxoni*** Borradaile1915.

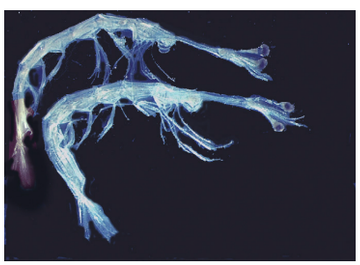
- The decapod Dendrobranchiate shrimps of the family Luciferidae De Haan, 1849 under the super family Sergestoidea Dana, 1852 were studied comprehensively to prepare a **Taxonomic Monograph** on the planktonic shrimps of the family **Luciferidae:** Genus: *Lucifer* from the Indian EEZ (zooplankton collections of the first **44** cruises of *FORV Sagar Sampada* from the Indian EEZ) and thus to record the diagnostic characters of the species constituting the family, their distribution and taxonomic placement in the seas around India. The monograph was finalized and submitted for publication.
- ***L. penicillifer*** Hansen, 1919 is the predominant species in the Arabian sea and Bay of Bengal while ***L. typus*** H.Milne Edwards, 1837 in the

island ecosystems. The neritic region of the Indian EEZ up to the 50 m depth support 51 % of these shrimps, mid shelf between 50 and 100 m harbour 29%, whereas 12 % in the outer shelf between 100 and 200 m and 8 % in the deep zone beyond 200 m.

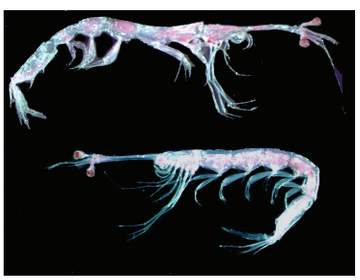
- In the fishery environment off Cochin up to 30 m depth zone ***L. hanseni*** is found to be the predominant species followed by three more species namely, ***L. typus*** H.Milne Edwards, 1837; ***L. penicillifer*** Hansen, 1919 and **L. *chacei*** Bowman, 1967 of which the last two are new records for the coastal area.

L. hanseni Nobili, 1905 male and female

L. penicillifer Hansen, 1919.male and female



L. typus H.Milne Edwards, 1837 male and female



L. chacei Bowman, 1967 male and female

PROJECT CODE	**FEM/07**
PROJECT TITLE	**GIS Based Atlas on Potential Mariculture Sites along the Indian Coast**
SCIENTISTS	**V.V. Singh,** Rani Mary George, Reeta Jayasankar, P.K. Krishnakumar, K. Vijayakumaran, S. Jasmine and Bindu Sulochanan
CENTRES	Mumbai, Karwar, Mangalore, Cochin, Mandapam, Chennai and Visakhapatnam

- Initiated development of first stage maps of potential mariculture sites of the designated areas by eliminating the places subjected to industrial pollution, mangrove vegetation, port and fishing harbors, tourism and pilgrim centers, shrimp hatcheries etc. In second phase of the work collection of coordinates and attributes was done from the short-listed sites.
- Networking and integrated links have been established with the Indian Institute of Remote Sensing (Dept. of Space) Govt. of India, Dehradun, National Remote Sensing Agency, Hyderabad and Bhabha Atomic Research Centre (BARC), Mumbai.
- Base maps of Maharashtra were developed for identifying potential mariculture sites and measuring them using GPS. Three potential mariculture sites were identified from coastal Karnataka viz., North of Byndoor, North of Mulki and South of Mangalore. Two sites in the Sarada Estuary adjoining South of Yelamanchili of South Rayavaram Mandal has been identified for small scale mariculture from Andhra Pradesh.

PHYSIOLOGY NUTRITION PATHOLOGY DIVISION

The Division implemented six in-house projects, three sponsored projects, and one NATP project in the frontier areas of nutrition, pathology, physiology, genetics and biotechnology. The Division Scientists also collaborated in the NATP sponsored – IVLP, ATIC and pearl culture projects, DOD sponsored marine mammals project, and in the in-house projects on organic farming of *Penaeus semisulcatus*, and selective breeding of pearl oysters. Besides, the Division scientists were actively involved in organizing the M.F. Sc and Ph. D programmes of PGPM and supervision of students.

Major achievements of the Division during the year were:

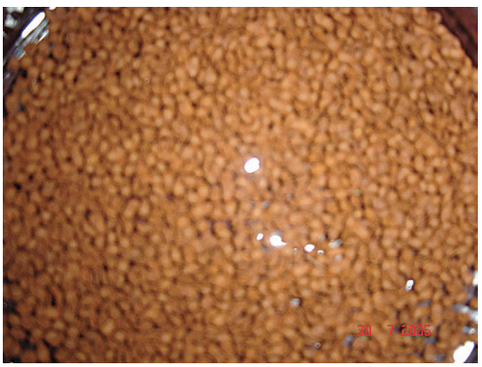
- The phytase producing *Bacillus* strain isolated from mangrove swamp has been identified by IMTECH and designated as IJ – *Bacillus licheniformis* – MTCC 6824.
- Process for purification of phytase enzyme from fermented product using the *Bacillus* has been standardised.
- Bio-enriched ornamental fish feed successfully used for many species of marine and freshwater fishes.
- Twenty-three solvent fractions of the purified extract from the marine plant, *Ulva fasciata* exhibited moderate to high antibiotic activity against several bacterial pathogens.
- A putative probiotic bacterial strain G23 (*Bacillus* sp.) isolated from healthy shrimp gut, resulted in significant improvement in disease resistance and immunological responses in *Fenneropenaeus indicus.*
- Indirect plate ELISA and indirect dot- ELISA techniques have been developed for rapid detection of *Vibrio parahaemolyticus* using polyclonal rabbit antisera.
- Phylogenetic relationship in four species of marine ornamental fish, *Abudefduf* was established.
- A microsatellite DNA sequence developed in the domesticated clown fish species *Amphiprion sebae* (AS 10, 129 bp size) was submitted to the GenBank (NCBI), which was released with the accession number DQ079821.
- Disease Diagnosis and feed composition analysis services have been rendered to aquafarmers through the ATIC, beside sale of feeds.
- PCR based diagnostic service for screening of post larvae for WSSV and MBV were provided to 35 shrimp farmers during the year.
- Training in PCR technique for molecular diagnosis of WSS Virus imparted to Agency for Development of Aquaculture, Kerala (ADAK).
- Training programme in Instrumentation Techniques in Biotechnology organized for faculty and students of Rai University, Cochin campus.
- The Division scientists served as faculty of the Winter School on " Recent advances in Mussel and Edible Oyster farming & Marine pearl production" conducted at CMFRI.
- The Division scientists published 15 research papers in peer-reviewed journals; the scientists also made 6 presentations in symposia and

conferences during the year, published 4 popular articles and 14 technical papers in Books/Bulletins.

- The Division scientists successfully guided 2 Ph. D. regular students/ SRF's in sponsored projects and 3 M. F. Sc dissertations.

PROJECT CODE	**PNP/NUT/01**
PROJECT TITLE	**Development of Cost-effective and Eco-friendly Feeds for Cultivable Marine Crustaceans and Finfish by Biotechnological Interventions**
SCIENTISTS	**R. Paul Raj,** Imelda Joseph, Kajal Chakraborty, P. Vijayagopal, D.C.V. Easterson, D. Kandasami and Margaret Muthu Rethinam
CENTRES	Cochin, Mandapam, Chennai, and Tuticorin

- The minimum fishmeal requirement in compounded diets of post larval *Penaeus semisulcatus* has been determined as 10% based on two experiments.
- In a comparative trial with four compounded feeds, a feed containing a mixture of protein sources of marine and plant origin (fish meal 35%, *Acetes* meal 7.5%, prawn head meal 7.5%, groundnut cake 25%) produced the best growth response of 0.53g per day with a gross conversion efficiency of 91.77% in *Portunus pelagicus*.
- A semi-moist diet prepared with a mixture of marine and plant ingredients, soy lecithin and gelatin and agar as binder produced superior growth in juvenile lobster, *Panulirus homarus* compared to two dry pellets.
- Shelf-life studies of bioenriched ornamental fish feed and fermented soybean meal (FSBM) have shown that the feed is more or less stable during six months storage period. A marginal reduction in crude protein, crude ash and crude fibre and NFE contents was observed in FSBM. *Vibrio* spp., *Streptococcus faecalis, Escherichia coli* or *Staphylococcus aureus* were not recorded during storage in the feed as well as FSBM.
- The growth phases of *Bacillus coagulans* were studied for 76h in Zobell marine medium. Lag phase lasted for 5h, exponential (log) phase for 18h (6-24h), stationary phase for 24 h (24 to 48h) and death phase started from 48 h onwards.
- An experiment was conducted to study the nutritional profile of wheat bran by solid state fermentation using *Aspergillus niger* strain $S_1$4 isolated from mangrove swamp. Significant improvement in crude protein and crude fat and a significant reduction in dry matter and total carbohydrate were recorded after fermentation for a period of 8 days. Among amino acids significant increases in aspartic acid, serine, threonine, alanine, valine, cysteine and lysine were observed during the course of fermentation, while a significant reduction in glutamic acid, arginine, methionine, phenyl alanine and tryptophan was observed.



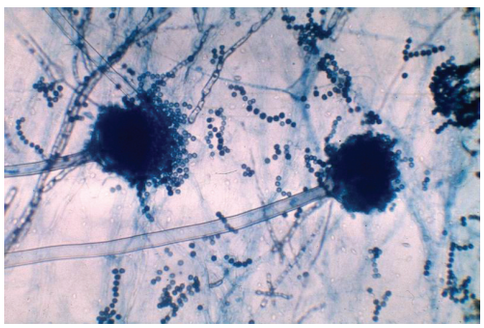
Compounded feed for *Portunus pelagicus*

Purification and characterization of phytase from a novel *Bacillus* from mangrove ecosystem

- Characterization of phytase producing *Bacillus* strain from mangrove swamp was carried out. The species was identified and designated as

IJ- *Bacillus licheniformis* MTCC-6824 by the Institute of Microbial Technology (IMTECH), Chandigarh.

- The strain was observed to be a motile, gram positive rod, with no pigmentation, catalase and oxidase positive, nitrate reducing, growing at 2-7% sodium chloride, with no growth at 4°C and exhibiting growth between 15-50°C and producing acid from glucose, sucrose and mannitol.
- The growth phases of *Bacillus licheniformis* MTCC-6824 was studied using zobell marie medium for a period of 76h in 500 ml conical flasks at room temperature (30 ± 2°C). A lag phase lasting for 2-3h, exponential (log) phase for 24h (3-27h), stationary phase lasting for 39h (27-66h) and death phase starting at 67h with gradual decline till 76h was observed.
- For phytase activity, the Micahelis Menten constant (Km) was 2651 p mol with a turnover rate of 26.47 p mol per second, which indicates very high catalytic activity of the enzyme
- To assess heat denaturation of the active site of enzyme, activity was measured directly at a series of temperatures between 10 and 120^0 C. The phytase from *Bacillus licheniformis* MTCC-6824 showed high intrinsic thermostability and even at temperature of 80^0 C, only slight (irreversible) enzyme inactivation was observed under the experimental conditions (with 80 per cent recovery).
- pH stability indicated an optimum pH of 5 for phytase activity and it was extremely unstable as the pH increased above 8.0, virtually with no activity above 9.0.
- Ca^{++} and Mg^{++} were found to be enzyme activators while both oxidized (Fe^{3+}) and reduced forms of iron (Fe2+) were inhibitors. Heavy metals like Zn, Sr, and Sn were strong inhibitors of phytase enzyme.



Aspergillus niger strain

PROJECT CODE	**PNP/PAT/01**
PROJECT TITLE	**Disease Monitoring and Management in Mariculture**
SCIENTISTS	**A.P. Lipton,** K.C.George, K.S.Sobhana, N.K.Sanil, Margaret Muthu Rethinam, S.R. Krupesha Sharma and Kajal Chakraborty
CENTRES	Vizhinjam, Cochin, Chennai and Calicut

- Two major bacterial diseases were recorded apart from fin and tail rot conditions in the marine ornamental fishes. The Peduncle Ulcer disease with characteristic ulcer symptoms in peduncle was caused by *Flavobacterium* sp. The strain was negative for cytochrome oxidase test and sensitive to Penicillin and Chloramphenicol. Three strains of *Vibrio* were isolated from the pearl oyster larvae.
- A predominant *Vibrio alginolyticus* strain was isolated from the 'Koran angel'. The strain of bacteria was sensitive to methanolic extract of marine macro alga, *Hypnea* sp.
- Pathogenic Vibrios have been isolated from the blood and kidney of diseased groupers, *Epinephelus malabaricus* maintained in the Marine Hatchery Complex of CMFRI. The bacterial strains isolated were characterized as *Vibrio anguillarum*, *V.parahaemolyticus* and *V. alginolyticus* .

- Survey of disease conditions in edible oyster farms at Kollam district revealed presence of Rickettesia like organism in ctenidia, mantles and digestive organs of 80% of animals.

Development of vaccines for management of vibriosis in grouper

- A highly virulent strain of *Vibrio anguillarum* has been isolated from diseased *Epinephelus malabaricus* and characterized.. Simple whole cell killed vaccine preparations from this strain are being tested for efficacy in controlling vibriosis due to *Vibrio anguillarum* in grouper.

New gut probiotics for effective management of disease problems in culture systems

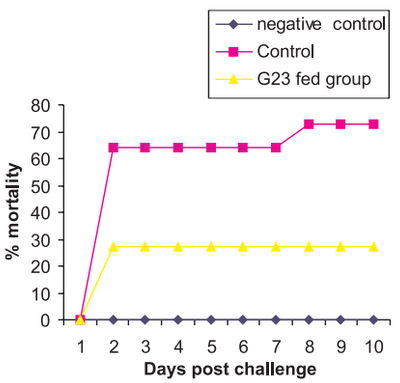
- A bacterial strain G23 (*Bacillus* sp.) isolated from healthy shrimp gut showed potential characteristics for use as gut probiotics for disease management in shrimp. G23 was tested in juveniles of the shrimp, *F. indicus* for assessing the effect on immunological responses and disease resistance. The groups fed on G23 incorporated diet showed significant improvement in disease resistance to *V. anguillarum.* It was found that the plasma bactericidal activity and the percentage composition of granulocytes in the hemolymph were significantly higher in the G23 supplemented groups as compared to control animals. The groups supplemented with G23 also showed good colonization of the probiont in the gut and significant reduction in total vibrio count in the gut of animals challenged with *V. anguillarum*.

Bioassay guided purification and characterization of bioactive compounds from the green alga *Ulva fasciata*

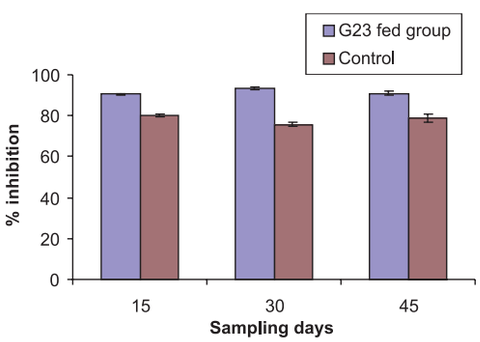
- Fresh and dried *Ulva fasciata* were extracted by methanol, ethanol and ethyl acetate, fractionated into hexane, chloroform, dichloromethane and n butanol. The chromatographic procedures like TLC or GLC were performed to monitor the profile of the compounds in the extracts.
- The extracts were then tested for antibacterial activity against *Pseudomonas aeruginosa, Vibrio alginolyticus, V fischeri, Serratia marcescens, Micrococcus luteus and Staphylococcus aureus*. The antibacterial activity was localized in the methanol, ethanol and dichloromethane methanol soluble fractions, which were chromatographed for "bioassay guided separation" of the active principle..
- A total of 74 fractions of purified *Ulva fasciata* extract were evaluated. Of these, 23 fractions exhibited moderate to high antibiotic, Artemia/ rotifer lethality. The antibiotic activity was evaluated using *Micrococcus luteus, Pseudomonas aeruginosa, Serratia marcescens, Staphylococcus aureus, Vibrio alginolyticus, V. fischeri* and clown fish isolate (CLY16J04).
- A total of 31 selected fractions including the above 23 with antimicrobial activity have been selected for structural elucidation.

Purification of lysozyme from the crystalline style of green mussel by alternate methods and testing its antibacterial activity

- Using size exclusion chromatography (CM Sephadex 25) with a yield of 25%, the purification achieved was only 16 –fold where as a highest



Cumulative percentage mortality in G23 fed and control groups of *F. indicus* juveniles upon injection challenge with *Vibrio anguillarum*



Plasma bactericidal activity in G23 fed and control groups of *F. indicus*

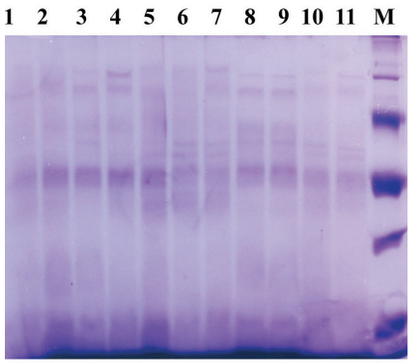
recovery of 96% with 45-fold purification was obtained with gel infiltration chromatography.

- The purified enzyme inhibited the growth of *Micrococcus luteus* (2.6 cm zone of inhibition) and *E .coli* (1.8 cm zone of inhibition) using lysoplate assay.

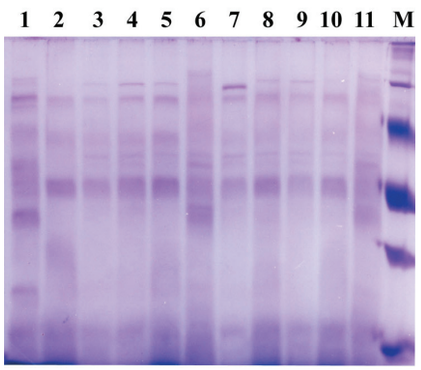
Cellular changes in the digestive gland of *Perna viridis*

- The cellular response of the digestive gland to copper and mercury (25 µg/l) included tubular dilation, tubular degeneration, and break down of tubules with desquamation of the cells into the lumen and destruction of cilia of the digestive diverticula.
- The incidence of tubular changes was significantly (p<0.01) higher in the metal exposed group when compared to control mussels.

PROJECT CODE	**PNP/BIOT/01**
PROJECT TITLE	**Development of Molecular and Immuno-Diagnostic Kits for Detection of Finfish and shellfish pathogen**
SCIENTISTS	**P.C. Thomas,** K.C.George, K.S.Sobhana and N.K.Sanil
CENTRES	Cochin



Cellular Protein Profile of *Aeromonas hydrophila* isolates resolved though SDS-PAGE.
Lane 1-11 : Ah_1-Ah_{11}; Lane M : Marker



Cellular Protein Profile of *Aeromonas hydrophila* isolates resolved though SDS-PAGE.
Lane 1-11 : Ah_{12}-Ah_{22}; Lane M : Marker

Isolation and characterization of bacterial pathogens of fish and shellfish

- A total of 35 strains of *Vibrio anguillarum*, 11 strains of *Vibrio parahaemolyticus* and 12 strains of *Aeromonas hydrophila* were isolated from diseased groupers, lobsters and clown fish and identified through biochemical characterization.

Molecular genetic profiling of bacterial pathogens

- Plasmid DNA profiling, antibiogram, cellular protein fingerprinting of twenty two *Aeromonas hydrophila* isolates from aquaculture systems confirmed on the basis of morphological and physiological test were carried out.
- Plasmid DNA isolated and resolved through agarose gel electrophoresis revealed 100 % plasmid occurrence. The plasmid profiles of the isolates showed diversity, the variations were in plasmid number and molecular size. The number varied from 1 to 4.The molecular size ranged from 1 to 21 kb.
- Eight different plasmid profiles were present on account of variations in the molecular size of the plasmid. A plasmid of 21 kb was found to be shared by all isolates. Eleven isolates contained only one plasmid viz. the 21Kb. These plasmid profiles were designated as 4(1), 4(2), 3(1), 3(2), 3(3), 2(1), 2(2) and 1(1), the first digit indicating the number of plasmids present in the profile.
- Resistance to 12 of the 20 antibiotics tested was similar among all the isolates concurrently with the 21 Kb plasmid shared by them. Differential resistance was shown by these isolates to 8 of the antibiotics.

Cellular protein profile

- Native-PAGE analysis of cellular proteins of the isolates revealed expression of a total of 11 different proteins, of which only six were

present in all the isolates. These were the six low molecular size proteins. The number of protein bands in an individual isolate ranged between 6 and 10.

- Eleven of the isolates expressed only commonly shared six proteins and therefore, had a similar profile. The other 11 isolates expressed the remaining 5 proteins additionally in varying combinations.
- The cellular protein fingerprint pattern generated through SDS-PAGE revealed a total of 14 different protein bands ranging from 18 KDa to >100 Kda of which three were expressed by all isolates while 11 were differentially expressed. The number of proteins present in a single isolate varied from 5 to 14. The SDS-PAGE profile revealed more diversity compared to the NATIVE-PAGE protein profile.

Electron microscopic profile of cell structure

- Transmission electron microscopy picture of normal cell structure of both *Vibrio anguillarum* and *V. alginolyticus* were generated and documented.

Pathogenicty evaluation of bacterial isolates

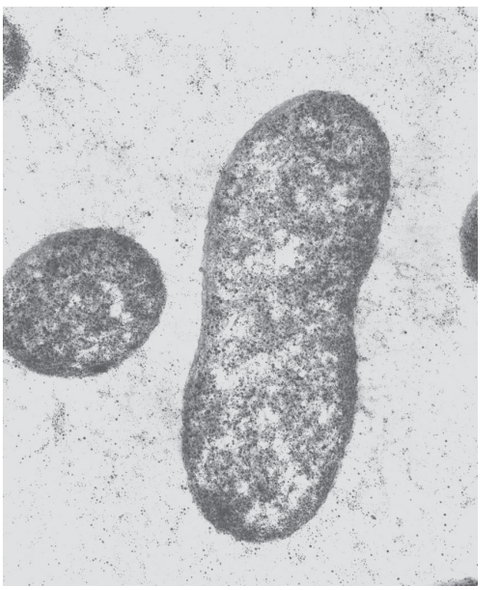
- Of the15 strains of *Vibrio anguillarum* tested for pathogenicty in juveniles of *P.indicus* one was non pathogenic while 100% mortality within one day was caused at a dose of 10^6 cells/animal by 9 strains and 10^7 cells/animal by 5 strains.
- Two out of the 4 strains of *Vibrio anguillarum* and the one strain of *V. parahaemolyticus* tested were found to be pathogenic in juveniles of groupers.

Molecular detection of pathogenic strains of *Vibrio parahaemolyticus*

- Work on the rapid detection and classification of pathogenic strains of *V. parahaemolyticus* of marine fish/shellfish through PCR amplification of the PR protein genes in them using specific primers was continued.

Development of immuno-diagnostics for bacterial pathogens

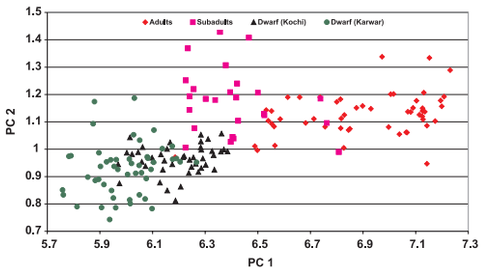
- Immunodot assay (dot ELISA), which does not need any sophisticated equipments was developed for the detection of *Vibrio parahaemolyticus*.
- Polyvalant antisera against *Vibrio anguillarum* were developed for immuno-diagnostic tests.
- Developed the counter immuno-electrophoretic diagnostic process for *Aeromonas hydrophila* antigens.



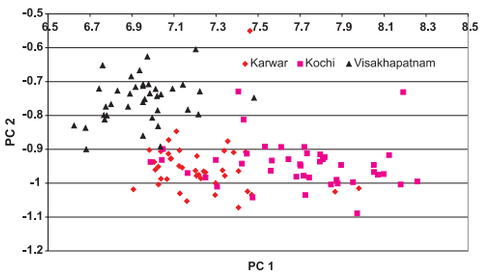
Ultra structure of *Vibrio*

PROJECT CODE	**PNP/GEN/01**
PROJECT TITLE	**Population Genetic Studies in Threadfin Breams and Sardines**
SCIENTISTS	**P. Jayasankar** and U. Rajkumar
CENTRES	Cochin and Visakhapatnam

- A total of 251 individuals of threadfin breams, *Nemipterus* spp (5 centres; 130-227 mm TL) and 370 of oil sardine, *Sardinella longiceps* (5 centres; 100-215 mm TL) were analyzed using phenotypic (Sheared Truss network) and genotypic (RAPD) approaches.
- There was a perceptible difference in truss morphometric clusters of



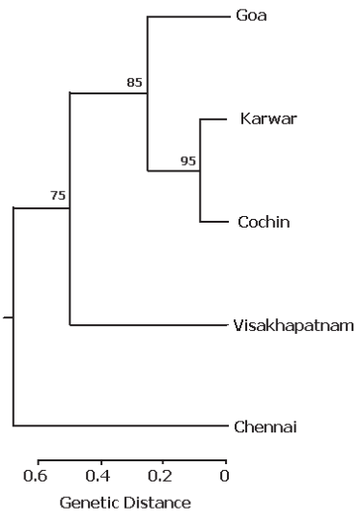
Sheared PCA of truss landmarks in *S. longiceps*



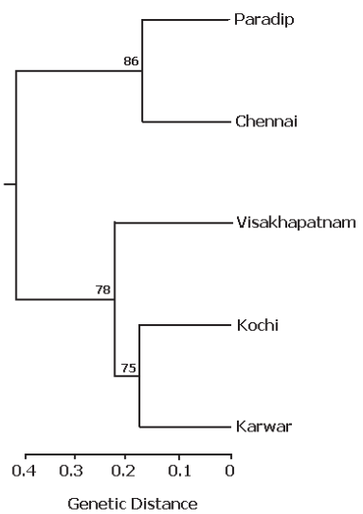
Sheared PCA of truss landmarks in *N. japonicus*

"normal" individuals and "dwarf/stunted" individuals of oil sardine; the latter were collected in huge quantity during Oct-Feb along the west coast.

- Marked variation in the truss morphometric clusters of *Nemipterus japonicus* between east and west coasts was observed.
- UPGMA dendrograms generated from RAPD fingerprinting of *S. longiceps* and *N. japonicus* indicated that by and large, populations of both the species from the east and the west coasts were separated. ANOVA and 2-sample t-test confirmed this observation. *Nemipterus mesoprion* had homogenous populations along both the coasts.



UPGMA dendrograms of *S. longiceps*



UPGMA dendrograms of *N. japonicus*

PROJECT CODE	**PNP/BIOT/02**
PROJECT TITLE	**Cryopreservation of Marine Fish Spermatozoa**
SCIENTISTS	**D. Noble,** L. Krishnan and Grace Mathew
CENTRES	Cochin

- Experiments were conducted to identify the best cryoextender–protectant combination for cryopreservation of spermatozoa of marine ornamental damselfish (Family: Pomacentridae).
- Three cryoexternders – Marine Teleost Ringer, Rana & McAndrew and V2E were tried.
- Dimethylsulphoxide (DMSO) 7.5%, Glycerine 5% and DMSO 5% and Glycerine 5%, along with each extender as cryoprotectant studied.
- All combinations could preserve the spermatozoa in viable form.

PROJECT CODE	**PNP/PHY/01**
PROJECT TITLE	**Development of Cost-effective Low Stress Methods for Live Transport of Fish and Crustaceans**
SCIENTISTS	**R. Paul Raj,** D.C.V. Easterson, D. Noble, G Gopakumar and Imelda Joseph
CENTRES	Cochin, Tuticorin and Vizhinjam

- Anaesthetization using clove oil of 60ppm concentration and 1.0 ppm in packing water was found to maintain sedative effect of juveniles damsel fish weighing 2-3g in each during transport.

- The microbial changes in the water in control and under sedation using 40 ppm clove oil for damsel fish for live transport (mean weight 4.9 g) was studied. It was observed to be 5 x 10^3 (CFU) for 0h, 15 x10^3 (CFU) for 1h for control and only 6 x 10^3 CFU after one hour under sedation.
- Optimum dose (µl/L) of clove oil as anaesthetic for other marine ornamental fish have been worked out. For Parrot fish (60 g size) 25 µl/L with an induction time of 40 sec; for Butterfly fish (20 g), 50 µl/L and induction time was 45 sec; for Abudefduf fish (40 g) 25 µl/L and induction time was 45 sec; Moonwrasse (40 g) 50µl/L and induction time was 70 sec for Surgeon fish (30g) 25µl/L and induction time was 60 sec.

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

The Division has undertaken 4 in house and 3 NATP projects during the year 2004-2005. The Division organized 3 exhibitions in different places and involved in conducting extension activities like demonstrations, interactive meetings, trainings and campaigns. The Division is also serving the fishers / farming community through the Agriculture Technology Information Centre (ATIC) by supply of technological inputs, products and services through the single-window delivery system. The division has published 2 research papers in International Journals, 2 research and 5 technical articles in National Journals, 15 papers presented in seminars and symposiums, released 4 books (2 in English,1 in Hindi, 1 in Malayalam), 12 animation films, 7 pamphlets (3 in English, 3 in Hindi and 1 in Malayalam) and 3 brochures (2 in English, 1 in Malayalam). The work of AP Cess fund scheme entitled "Economic Evaluation of Trawl Fishing in Andhra Pradesh and Kerala" has been initiated by the division and another inter institutional network mode project entitled "Impact of Tsunami on the Damage to the Assets and its Effect on the Socio-Economic status of Coastal Communities" was approved by the council.

PROJECT CODE	**SEE/PMS/01**
PROJECT TITLE	**Price Behaviour and Marketing System of Marine Fisheries in India**
SCIENTISTS	**R.Sathiadhas,** R.Narayanakumar and N. Aswathy
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

Women fish traders awaiting the arrival of boats

Heaps of fish for auctioning

- On the basis of the price structure, economic evaluation of marine fish landings for 2004 has been done. The value of the fish at first sales was estimated at Rs 13, 019 crore and at last sales Rs 22,353 crore. Crustaceans alone contributed Rs 5, 768 crore at first sales and Rs 10,295 crore at last sales forming about 40% of gross revenue.
- Average percentage share of fishermen in the consumers' rupee ranged from 40 % for oil sardines to 77 % for penaeid prawns and rock cods.
- The annual average landing centre price ranged from Rs 18 /- per kg for oil sardines to Rs 95 /- kg for pomfrets among the varieties traded in the internal marketing system. At the same time, the average landing centre price of exportable varieties ranged from Rs 167 /- per kg for penaeid prawns to Rs 470 /- per kg for lobsters.
- At the consumer level, the average retail price ranged from Rs 22 / kg for oil sardines to Rs 152 / kg for pomfrets among the varieties traded in the internal marketing system. For the exportable varieties, the average retail price ranged from Rs 174 /kg for penaeid prawns to Rs 504 / kg for lobsters.
- The Coefficient of Variation (CV) of the monthly fish prices was worked out to analyse the price fluctuations. It was found that in Andhra Pradesh, the varieties like anchovies (CV of 11.90 %) and rock cods (11.04 %) maintained a comparatively stable price in wholesale and retail markets. In Kerala, the highest monthly fluctuations was observed for sharks (43 %) and the lowest for snappers and pig face breams (12 %) across different seasons.

PROJECT CODE	**SEE/ECO/01**
PROJECT TITLE	**Economics of Marine Fishing operations**
SCIENTISTS	**R. Narayanakumar,** R. Sathiadhas and Aswathy, N
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

- Data on operational costs and earnings of different craft-gear combinations were collected at selected centres for all the maritime states.
- The gross capital investment on fishing craft and gears in Indian marine fisheries sector in 2004 works out at Rs.10, 532 crore in which mechanised sector constitutes about Rs.9,049 crore, more than a three-fold increase of over 1996-97. The increase in investment on mechanised trawlers and gill-netters are comparatively higher than other sectors. The capital investment on motorised sector also almost doubled from Rs.456 crore during 1996-97 to Rs.861 crore in 2004.
- The overall per capita investments of an active fisherman in 2004-05 was Rs.86,290 ranging from Rs.17,024 in the non-mechanised sector to Rs. 2,19,319 in the mechanised sector. It is quite interesting to note that the per capita investment of motorised sector declined from Rs. 26,835 in 1997 to Rs. 19,454 in 2004.
- The annual per capita earnings of a fishing labourer ranged from Rs.12,600 for a non-mechanised gillnet unit to Rs.1,27,200 in a multi-day purse seine unit.
- The capital productivity of trawling operations, measured through operating ratio was estimated at 0.5 for multi-day trawling in Andhra Pradesh.
- In Tuticorin, the operating ratio of motorized crafts with gillnets (multi-day) was worked out to 0.55 against 0.65 for a motorized craft with bottom-set gill net. It is seen that, higher the operating ratio, lower is the economic surplus.

Landed fishing boats after harvest

Sorting of the landed fish

PROJECT CODE	**SEE / ITK / 01**
PROJECT TITLE	**Indigenous Knowledge Systems and Community based Resource Management in Marine Fisheries**
SCIENTISTS	**S. Ashaletha,** C.Ramachandran, R. Narayanakumar, Sheela Immanuel and Vipinkumar,V.P
CENTRES	Cochin, Tuticorin, Chennai, Mangalore, Karwar, Visakhapatnam and Kakinada

The ITKs' prevalent in Kerala, Karnataka, Tamilnadu and Andhra Pradesh have been consolidated and classified under 8 major categories such as

A.	Craft and Gear making / Maintenance	:	55
B.	Shoal identification	:	27
C.	Harvesting methods	:	25
D.	Predicting natural hazards	:	15
E.	Preservation techniques	:	17
F.	Processing	:	05
G.	Medicinal uses	:	05
H.	Beliefs and Value systems	:	32

Smearing Cashew nut oil on craft wood for durability in Karwar

- Some of the ITKs' for craft and gear making / maintenance are sardine oil smearing on craft wood, smearing cashew nut oil on craft wood, dipping cotton nets in bamboo bark decoction and waste oil mixed with lime applied in the craft after making perforations for durability.
- With regard to the Shoal identification, black colour of sea water indicates the presence of mackerel / sardine, white colour of sea water indicates the presence of pomfret, high blue colour of sea water indicates the chance of less catch and dark blue colour of sea water indicates the chance of heavy catch.
- The occurrence of *dakshin gali* indicates the arrival of monsoon, presence of worms in shoal / bubbles on sea surface indicates the chance of storm, but the presence of black cloud and rough sea indicates the chance of heavy rain with violent storm.
- Eating ribbon fish (*Trichurus*) for lactating women, silver belly for recovering from dysentery and shark oil pellet for relief against stomach disorders are some of the ITKs' pertaining to medicinal uses.
- Analysed the perception of fisherfolk in Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. More than 80 % opined that ITKs' are to be preserved and applied with suitable modifications.

PROJECT CODE	**SEE / TOT / 02**
PROJECT TITLE	**Livelihood Analysis of Coastal Fisherfolk for Technological Empowerment**
SCIENTISTS	**Ashaletha.S,** Vipinkumar.V.P, Sheela Immanuel and S.Swathilakshmi
CENTRES	Cochin, Chennai, Mangalore and Visakhapatnam

- The focus of the project was on collection of socio economic information on different stakeholder categories of marine fisheries sector of Karnataka, Kerala, Tamil Nadu and Andhra Pradesh and to assess the livelihood conditions of coastal fishers and prioritization of technological needs for their empowerment.
- Done the PRA and collected information on different stakeholder categories of Karnataka coast. Other than those engaged in harvest sector, fisherfolk are employed in beaches, markets, processing centers, ice plants, freezing plants, fishmeal plants, net mending and petty shops in landing centers. Seasonality of occupation, dwindling of fish catch, lack of information on alternate occupation, lack of access to information, and improper infrastructure support were the major constraints.
- In Kerala, PRA was undertaken in *Payyoli of Calicut* and *Edavanakkad* of *Ernakulam* districts for assessing the technology needs and prioritization. Identified stakeholder categories and their constraints. Lack of credit, lack of training for value addition techniques, poor economic background and high indebtedness were the major constraints. Scope of interventions is prioritized as preparation of dry fish products, fish processing, value added products, ready to eat & ready to cook fish products, ornamental fish culture, mussel culture and edible oyster culture.
- In Tamil Nadu, PRA was conducted in 3 villages such as *Nellikuppam*, *Puthiya Kaeppakkam* and *Chemamcheri* of *Kancheepuram* and *Thiruvallur* districts. Poor catch, lack of support for brackish water

aquaculture, lack of training for value addition and poor health care were the major constraints. The prioritized interventions are SHG formation for women and starting fish processing / value addition, more credit provision and promoting aquaculture.

- In Andhra Pradesh, PRA was done and collected information on different stakeholder categories of *Visakhapatnam* coast. Fisherfolk are employed in markets, processing centres, ice plants and fish drying units. Lack of information on alternative occupation, improper infrastructure support and lack of training on skill improvement were the major constraints. Value addition of fisheries and agricultural products and better marketing facilities are the feasible interventions.
- Through PRA, a birds' eye view of the socio economic situation in the form of resource map, social map, Venn diagrams, fishery seasonal calendar, mobility map & daily routine analysis of women prevailing in the coastal villages of Karnataka, Kerala, Tamil Nadu and Andhra Pradesh was obtained.

PRA at *Chemmencheri*: Daily Routine Diagram drawn by fisherwomen

MARICULTURE DIVISION

The Mariculture Division of the Institute came into existence from 19.04.2004 with 14 scientists for focused and integrated research on mariculture. A brainstorming session was organized on 3rd and 4th November, 2004 at Mandapam Regional Centre of CMFRI for formulation of the projects for the Division. Prof. (Dr.) Mohan Joseph Modayil, Director, chaired the session and all the scientists of Mariculture Division participated in the session.

MARINE BIODIVERSITY DIVISION

- The Marine Biodiversity division of the institute came in the existance from 19-04-2004 with 11 scientists for focussed research on Marine Biodiversity.
- Organized and conducted a **National Hindi Seminar for Scientists on Issues in Aquatic Biodiversity** at CMFRI, Cochin-18 on 01-02-2005. Altogether **15** papers through three Technical Sessions were presented on various issues in Aquatic Biodiversity from different parts of the country and published as Proceedings of the Hindi National Seminar in a **Special Publication of CMFRI, No. 84.**
- A **Brainstorming Session on Biodiversity** was held on 23rd and 24th February 2005 at Cochin.

SPONSORED PROJECTS

FUNDING AGENCY	**DOD**
PROJECT TITLE	**Predictive Modeling in Marine Fisheries of South West Coast of India**
SCIENTISTS	**M. Srinath,** T.V. Sathianandan, Somy Kuriakose and Mini, K.G
CENTRE	Cochin

The project focuses on development of suitable univariate and multivariate predictive models for the marine fishery resources of southwest coast of India and estimate the inter relationship between the exploited stocks, the climatic and oceanographic parameters based on a cross correlation analysis.

- Univariate Time Series models were fitted for the South West coast of India based on estimated annual and quarterly landings for the period 1960 to 2003. Seasonal ARIMA models were identified for the total landings and major 14 exploited species. For each species 5 models were selected based on the R^2 values.

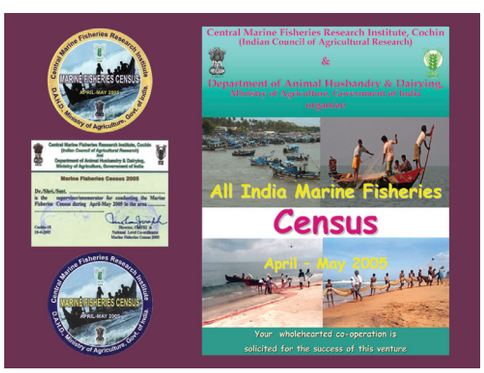
Seasonal ARIMA models for the South West Coast

No	Species	ARIMA Model (Annual)	ARIMA Model (Quarterly)
1	Elasmobranchs	(0,0,1), (1,1,0), (2,0,0), (0,1,1), (2,1,1)	(1,1,3), (2,0,3), (3,1,1), (4,1,1), (1,0,4)
2	Catfish	(0,0,1), (2,1,0), (1,2,0), (1,1,1), (3,1,0)	(4,1,0), (2,1,4), (1,0,4), (0,1,4), (1,1,4)
3	Oil Sardine	(4,1,0), (3,2,0)	(3,1,4), (2,1,5), (4,1,4), (5,0,4)
4	Whitebait	(0,1,1), (1,0,1), (3,1,0), (2,1,2)	(4,1,0), (5,0,0), (3,0,4), (2,1,4), (0,0,4)
5	Perches	(1,1,0), (0,0,2), (0,1,2)	(4,1,0)
6	Croakers	(0,1,1)	(3,0,4), (3,0,4), (4,0,0)
7	Ribbonfish	(0,0,1), (2,1,0), (4,0,1)	(3,1,1)
8	Carangids	(0,0,1), (1,1,0), (2,0,0), (1,1,2), (2,0,2)	(2,0,3), (4,0,1), (3,1,1)
9	Mackerel	(1,0,1), (0,1,1), (2,0,0), (1,1,0), (1,1,1)	(4,0,0), (3,1,0), (3,0,4)
10	Seer fish	(0,0,1), (1,1,0), (2,0,0), (2,0,1)	(2,1,2), (4,0,1), (3,1,1), (5,0,0)
11	Tuna	(1,0,0), (0,1,0), (0,0,1), (0,1,1)	(4,0,0), (3,1,0), (2,1,4), (3,0,4), (0,0,5)
12	Soles	(1,0,0), (0,1,0), (0,0,1), (0,1,1), (1,0,1),	(1,1,3), (4,0,1), (3,1,1)
13	Penaeid Prawn	(1,0,0), (0,1,0), (0,0,1), (0,1,1), (1,0,1)	(3,0,4), (2,0,4), (3,0,4)
14	Cephalopods	(2,2,0), (3,1,0), (4,1,0), (3,2,0),	(4,0,2), (5,0,0), (4,1,0),
15	Total Catch	(0,0,1), (1,1 ,0), (2,0,0), (2,0,2)	(3,1,4), (2,1,5)

- Studied the Impact of introduction of crafts with outboard engines on marine fish production in Kerala and Karnataka using intervention analysis. This was examined by adopting seasonal ARIMA and regression models with ARMA type errors. The effect of intervention was calculated from the estimated regression coefficient corresponding to auxiliary variables and an increase of about 56,463 in quarter wise marine fish landings was observed in Kerala due to introduction of outboard engines. In the case of Karnataka, it was found that on an average there is an increase of about 88 thousand in the annual total marine fish landings due to the intervention.
- A four state Markov chain model is applied to study the changes in the landings and long term projection of the Marine fish landings a of south-west coast of India. Time series of marine fish landings in South-west coast of India during 1961 to 2003 was examined by Markov chain model after transition probability matrices were derived from the data series. Using these matrices, the estimated steady state value of exploited marine fish landings along south west coast of India is 6.57 lakh tonnes. The projection indicates that there will be decline in the landings in the long run, if the present mode of exploitation is continued.
- The dynamics of the pelagic resource assemblage along the Karnataka Coast is analysed with reference to the change in resource composition and relative dominance using Markov chain. The transition probabilities of the species dominance with respect to four dominant groups namely oil sardine, mackerel, carangids and whitebaits along the Karnataka coast have been estimated. The analysis indicated that in the long run the pelagic fish assemblage of Karnataka coast is more likely to be dominated by oil sardine rather than mackerel.

FUNDING AGENCY	**Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, Govt. of India**
PROJECT TITLE	**Marine Fisheries Census 2005**

The Census was aimed at collection of essential information on the number of fishing villages, landing centres, fishermen population, active fishermen, fishing crafts and gears including the infrastructure facilities for planning developmental programmes in different maritime states of India. The census was also focused on getting information on characteristics of the fisherfolk including their community, educational and occupational status, membership in co-operative societies etc. besides their holdings of craft and gears.

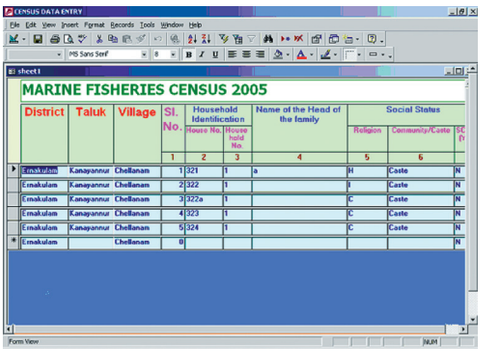


Publicity materials

- The basic information from the households have been collected through personal interviews and recorded in specially prepared schedules, that have been designed to cover the entire gamut of parameters comprising family size, education, occupation status, inventory of craft and gear, other fishing related equipment apart from information on skill acquisition through specialized training etc.
- Two types of schedules were designed ; Schedule I and Schedule II. Schedule I was prepared bilingual format, with English and vernacular language of the respective maritime state. Schedule I was intended to record family-wise information of the coastal fisherfolk with family

size, educational and occupational status, the number and type of craft and gear owned/shared by the family etc. All items of information were collected through complete enumeration by visiting individual households by the enumerators. (The enumerators were appointed on contract basis and special training was given for filling up the schedules). Schedule II was designed to obtain details on the infrastructure facilities, such as freezing plants, curing yards, processing plants, ice factories, landing centers and details of craft and gear etc. They were collected through complete enumeration by the field level supervisors.

- Training programmes were also organized for the Zonal/Field/District level supervisors at Mandapam, Chennai, Visakhapattinan, Mangalore, Mumbai and Cochin during Jan – Feb, 2005.
- Publicity materials, handouts and instructions to fill up the schedules have been prepared and distributed to all stations. Instructions were prepared in both English and vernacular language.
- During the first phase i.e, **15th April to 15th May, 2005**, the census operations have been completed for all the maritime states except Tamil Nadu and UT of Pondichery (TN Coast).
- The software for data entry and analysis was also developed by the Division.



FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Increasing Fish Production Through Artificial Fish Habitats**
SCIENTISTS	**E. Vivekanandan** and G. Mohanraj
CENTRE	Chennai

- Three types of Artificial Fish Habitats (AFH) viz. HDPE structure (1 no.), Ferrocement module (50 nos.) and concrete ring (100 nos.) were installed off Chinnandikuppam, about 20 Km south off Chennai. The structures were installed at a depth of 20 m. The fishermen were trained for fabricating and deploying the structures.
- During April 2003 to July 2004, an estimated 3844 h of fishing was conducted; an estimated 6404 kg fish worth Rs. 2,74,000 was caught from the reef area. Quality fishes such as snappers (28%), and carangids (20%) were dominant in the catch.

FUNDING AGENCY	**DOD**
PROJECT TITLE	**Investigations on the Effect of Bottom Trawling on the Benthic Fauna off Mangalore Coast (DOD)**
SCIENTISTS	**P.U. Zacharia**
CENTRE	Mangalore

- Estimation of discards from SDF(Single Day Fishing) was carried out by onboard participation and MDF(Multi Day Fishing) by harbour surveys. Discards formed 44.2% of all fish catch in SDF and 10.6% in MDF. Catch of targets and juveniles and depth of operation in SDF showed a negative correlation, whereas non – targets showed positive correlation.
- The study revealed that bottom trawling could make significant

changes in Total Suspended Solips (TSS) and turbidity.

- Significant changes in organic carbon and reduction in clay content of the sediment were also seen.
- There was an increase in biomass and numerical density of macrobenthos in shallow waters, but less in deeper waters.
- Biodiversity impact studies from experimental trawling indicated fishing pressure on total catch and non – target catches off 10 and 50 m.
- The study clearly points to the negative impact on the biodiversity and taxonomic diversity on the benthic organisms which was more evident in shallow waters.

FUNDING AGENCY	**Marine Products Export Development Authority**
PROJECT TITLE	**Participatory Management and Conservation of Lobster Resources along the Southwest Coast of India**
SCIENTISTS	**E.V. Radhakrishnan**
CENTRE	Cochin

- Posters, pamphlets and stickers on lobster conservation printed and distributed in lobster landing centres and fishing villages in Tamilnadu, Maharashtra and Gujarat.
- Display of colour slides on lobster conservation in local movie theatres (Nagercoil and adjacent places) where fishermen frequent to see movies.
- 'V' marked egg bearing lobsters procured from fishermen were released back into the sea at Khadiyapatnam.
- Video filming of lobster conservation programmes on the southwest coast interrupted by tsunami. Filming to begin in Maharashtra and Gujarat.
- A preliminary campaign on lobster conservation and protection of egg bearing lobsters was completed in Tamil Nadu. 40 villages were visited and meetings organised.
- Two Australian experts Dr. B.F. Philips and Dr. Ravi Fotedar visited Khadiyapatnam and had interaction with lobster fishermen.
- Operation of CIFT designed lobsters traps were monitored. Suggestions to improve the catchability of traps and difficulties in operation of the trap are being considered.

Lobster conservation stickers
(Tamil, Marathi and Gujarathi)

FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Reproductive Dynamics of Penaeid Shrimps of Mumbai Waters**
SCIENTISTS	**V. D. Deshmukh**
CENTRE	Mumbai

- Reproductive biology of eight commercially important species of penaeid shrimps namely, *Fenneropenaeus merguiensis*, *Metapenaeus affinis*, *M. monoceros*, *M. brevicornis*, *Parapeneopsis sculptilis*, *P. stylifera* and *Solenocera crassicornis* was investigated by sampling at Mumbai (3 landing centres) and at Harnai (Ratnagiri district).
- Size at maturity by logistic curve in mm was 123.1, 89.1, 105.8, 80.5, 62.5 and 45.5 for the males and 131.2, 109.2, 125.4, 115.0, 113.4,

82.4 and 87.1 for the females of the species in same order.

- Mature females of all the species occurred throughout the year but gonado-somatic index and percentage of mature females indicated two peaks of spawning; February and October for *F. merguiensis*, March and October for *M. affinis*, May and August for *M. monoceros*, January and October for *M. brevicornis*, April and December for *P. stylifera*, August and May for *P. sculptilis* and for *S. crassicornis* February, April and September.
- Ova diameter studies indicated that mature eggs are shed at one instance and rematuration of ovary is fast enough to enable spawning at the interval of about a month in most of the species.
- Sex-ratio of all the species was in favour of females which changed disproportionately during spawning period.
- Among the species, *P. stylifera*, *M. affinis*, *S. crassicornis* and *F. merguiensis* exhibited distinct seasonality with two spawning peaks, one in pre-monsoon and the other in post monsoon period to produce two broods or cohorts; however, the former contributed to the fishery largely. In the case of *M. monoceros* monsoon spawning contributed to the bulk of the recruits and the fishery.
- With size-fecundity relationships and length based VPA for each species, monthwise population fecundity index (PFI) was estimated.
- Biological reference point of spawning stock biomass per recruit for almost all the species was found to be above the critical limits.

FUNDING AGENCY	**Department of Fisheries, Govt. of Kerala**
PROJECT TITLE	**Development of Artificial Reefs along the Kerala coast (Kannur)**
SCIENTISTS	**K.K.Philippose**
CENTRE	Calicut

- During the study period 1.9 t of lobsters were landed by 1400 units from the reef at Muttom.
- Lobsters formed 66.5% of the total catch. *P. homarus* alone formed the lobster fishery.
- Catch per effort was estimated to be 1.357 kg/unit.
- There was no fishery during June and July months due to heavy monsoon and rough sea conditions.

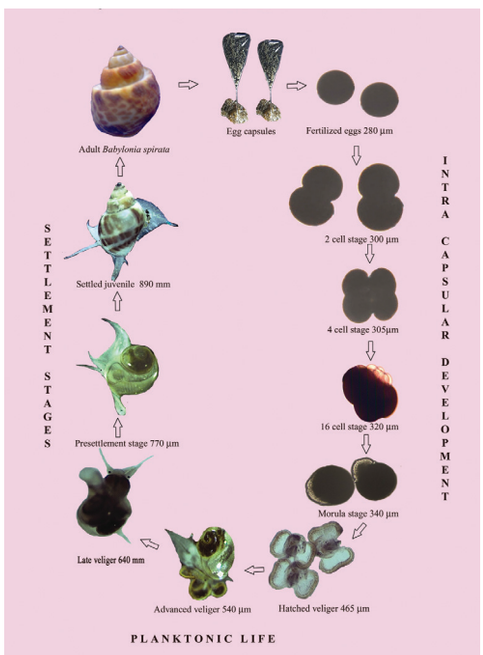
FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Development of Sea Farming Technology for the Whelk, *Babylonia* spp.**
SCIENTISTS	**K. K. Appukuttan** and P. Laxmilatha
CENTRE	Cochin

Completion report of the project has been sent to the ICAR by October 2004.

- The fishery of *B. spirata* represented the size range of 34-44 mm while *B. zeylanica* represented 40-48 mm range. Female population dominated the fishery throughout the study period. Histological studies of gonad were carried out for maturity stages.
- Live *Babylonia* spp. was brought to hatchery for rearing experiments.

The broodstock was maintained in 1 tonne tanks with optimum water quality and feed. Continuous spawning obtained in these tanks from September to March. Experiments were set for optimum water quality parameters, feed and feed concentration, stocking density and substratum for the rearing of larvae.

- Optimum stocking density of larvae was 150 larvae/l in which the settlement was 69.8 %. Growth rate of juvenile was found to be 0.06 mm/day. Juveniles attained the shell length of 31 mm, width 21.3 mm and weight 10 gm by 18 months.
- Among the two species available in India, *Babylonia spirata* contribute a major portion of bycatch in day trawlers and they prefer clayey bottom, whereas *B. zeylanica* are caught north of Kollam in multi day trawls and they prefer sandy bottom. The total production of whelk from 2001 – 2003 was 1064 t with an average production of 355 t/year. The highest production is observed in the month of May every year. In *B. spirata* the 30-48 mm size groups dominate the fishery. The meat percentage varied from 39-63 % with maximum meat yield in May and June. Females dominated the catch. Meat weight varied from 40-48% with maximum weight in April-May period. Females dominated the catch.
- Viable methods for collection, transportation and maintenance of brood stock were developed by repeated experiments in the hatchery.
- Several spawning experiments of *Babylonia spirata* were done in the hatchery and most of them were successful. Average spawn size was 36-40 mm. Egg capsules with 500-900 eggs were obtained.
- Development of egg from 1st cleavage to settlement of young ones was studied in the hatchery. Veliger stages were released from the capsule on 6th & 7th day with an average shell length of 450µm. Metamorphosis was completed in 17-19 days. Settlement starts from 19th day when they reach a size of 800-1000 µm.
- Larval rearing and post - settlement till juvenile stage were done in the hatchery. Different stocking densities, feed materials were tried with various larval stages. Substrate preference, effect of environmental changes especially salinity on hatching and settlement was also studied. Optimum conditions for larval rearing were observed.
- Field experiments for sea farming of Whelk were conducted in two sites one at Thankassery and another at Neendakara.



Life cycle of *Babylonia spirata*

FUNDING AGENCY **IFS**
PROJECT TITLE **Environmental Impact Assessment of Suspended Culture of Bivalves**
SCIENTISTS **V. Kripa**
CENTRE Cochin

- The impact of hydrographic parameters such as nutrients, salinity, dissolved oxygen and temperature on farm was negligible. Reduction in water flow within the farm (0.024 m sec^{1}) from a flow rate of 0.025 m. sec^{-1} outside the farm and 0.510 m sec^{-1} in deeper open areas was observed.

- Continuous suspended culture leads to reduction in fine sand from 70 to 55% and coarse sand from 19 to 13%. Percentage of silt and clay increased from 3 to 11% and 8 to 21%, respectively.
- The total organic carbon content was found to increase due to continuous farming. The density of benthic fauna in a one-year-old farm was higher (52,023 nos m^{-2}) than the control site (27,746 nos m^{-2}) while it was low (8,092 nos m^{-2}) at seven-year-old farm.

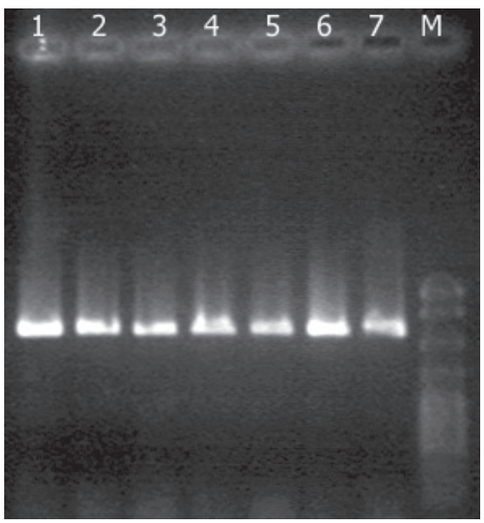
FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Assessing the Impact of Fisheries on the Biodiversity of Marine Fish Resources of Southwest Coast of India**
SCIENTISTS	**K. S. Mohamed,** P.U. Zacharia, P.K. Krishnakumar, T.V. Sathianandan and P.K. Asokan
CENTRES	Mangalore, Kozhikode and Cochin

- To assess the changes in species composition and biomass due to fishing on marine resources of Southwest coast of India between 1960 and 2000 data mining that includes extracting raw data available in the records of National Marine Living Resources Data Centre (NMLRDC) of CMFRI was started.
- Catch and effort data were sorted state-wise as well as zone-wise. Species-wise sorting for catch and effort data of southwest coast of India (Kerala, Karnataka and Goa) is proposed to be done in order to quantify biodiversity loss.
- Carried out literature review on biological information of commercially important fishes (*Sardinella longiceps, Rastrelliger kanagurta, Cynoglossus macarostomus*) and prawns. Information regarding mean size, size at first maturity, sex ratio and generation time of the above species were collected from the published data for creating a data base.

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Studies on Marine Mammals of Indian EEZ and the Contiguous Seas**
SCIENTISTS	**M. Rajagopalan,** E. Vivekanandan, P.K. Krishnakumar, P. Jayasankar and K.P. Said Koya
CENTRES	Cochin, Mangalore, Chennai, Mandapam, Visakhapatnam and Minicoy

- During 2004-2005, 215 days were spent on board FORV *Sagar Sampada* and made 146 sightings of mammals from Bay of Bengal and Arabian Sea (Cruise numbers 223 – 232). Two species of whales *viz., Balaenoptera borealis* and *Physeter macrocephalus* and 5 species of dolphins *viz., Stenella longirostris, Stenella coeruleoalba, Sousa chinensis, Delphinus delphis* and *Pseudorca crassidens* were positively identified on many occasions. Apart from this many unidentified dolphins and whales have also been recorded during cruises.
- The presence of two types of Hump back whales *Sousa chinensis* with hump and without hump have been repeatedly sighted and photographed on both east and west coasts. This species needs special

Sperm whale *Physeter macrocephalus* sighted on board FORV *Sagar Sampada*



Cytochrome b PCR products of cetaceans : lanes 1 and 2, *Tursiops aduncus*; 3 & 4, *Stenella longirostris*; 5, *Delphinus delphis*; 6, *Grampus griseus*; 7, *Physeter macrocephalus*; M, DNA size marker

attention while drafting any action plan for conservation and management purpose.

- During 2004-2005, a total of 28 dolphins were collected from Chennai, Visakhapatnam, Mangalore and Vizhinjam. Samples of two specimens of finless porpoise from Malpe and of a sperm whale from Chennai was also collected.
- Samples of liver, kidney, muscle, stomach contents, skin and teeth were collected from accidentally died five species of dolphins *viz.*, spinner, bottlenose, common, Risso's, Indo-Pacific humpbacked dolphin, a species of porpoise, finless porpoise and a stranded sperm whale for pollution and genetic studies.
- A total of 23 elements in liver, kidney, muscle were analyzed from 16 specimens of spinner dolphins *Stenella longirostris* and 2 specimens of finless porpoise *Neophocaena phocaenoides* collected from Chennai, Visakhapatnam and Mangalore using ICP. Tissue concentration of elements differed in different matrices of the same animal. Further geographical difference was observed from the same species *Stenella longirostris*.
- Genomic DNA extraction procedure from skin samples was standardized. RAPD using OPA08 & OPF03 showed very little genetic variation among *Stennella*, *Tursiops* and *Delphinus delphis* samples. Mt DNA PCR of Cytochrome B region and Control region was carried out using specific primers. Single specific band obtained (in all samples of dolphins and sperm whale) for 5 pairs of primer combinations.
- Work is progressing on the gel elution of specific bands and restriction endonuclease digestion using Restriction Endonucleases, such as *Bam*HI, *Bcl* I, *EcoR* I and *Pvu* II to detect any possible RFLPs among the species.

Primers	5'-3' sequence	PCR product size (bp)
Cytochrome b		
GLUDG-L (F) CB2-H (R)	TGA CTT GAA RAA CCA YCG TTG CCC TCA GAA TGA TAT TTG TCC TCA	432
CYBMF-L (F) CYBMR-H (R)	GAA CTA TAA GAA CAC TAA TGA CCA A TGA TTC AGC CAT AGT TAA CGT CTC GAC	238
Control region M13-Dlp1.5-L Dlp5-H	TGT AAA ACG GCC AGT TCA CCC AAA GCT GRA RTT CTA CCA TCG WGA TGT CTT ATT TAA GRG GAA	527
M13-Dlp1.5-L Dlp8G-H	TGT AAA ACG GCC AGT TCA CCC AAA GCT GRA RTT CTAGGA GTA CTA TGT CCT GAA CA	404
Dlp4-H Dlp10-L	GCG GGW TRY TGR TTT CAC G CCA CAG TAC TAT GTC CGT ATT	309

Sightings of Cetaceans on board FORV *Sagar Sampada*

Cruise No.	Period	No. of sightings	Area of observations
223	18.3.04 to 6.4.04	15	South west coast of India
224	12.4.04 to 1.5.04	10	North west coast of India
225	11.5.04 to 3.6.04	18	East coast of India
226	7.6.04 to 10.7.04	20	Off Andaman & Nicobar Islands
227	17.7.04 to 31.7.04	7	South west coast of India
228	2.9.04 to 21.9.04	14	North west coast of India
229	27.9.04 to 15.10.04	23	South west coast of India
230	5.1.05 to 18.1.05	7	South east coast of India
231	23.1.05 to 16.2.05	21	Off Andaman & Nicobar islands
232	18.2.05 to 16.3.05	11	East coast of India

FUNDING AGENCY **ICAR (National Network Project of NRM Division)**
PROJECT TITLE **Impact, Adaptation and Vulnerability of Indian Fisheries to Climate Change**
SCIENTISTS **M. Rajagopalan,** N.G.K. Pillai, M. Srinath, Rani Mary, George, E. Vivekanandan, P.K. Krishnakumar, P. Kaladharan, Reeta Jayasankar and K. Vijayakumaran
CENTRES Cochin, Mangalore, Chennai and Visakhapatnam

- Regime shifts in the marine ecosystem of Northern Indian Ocean (NIO) were studied by using time series on ocean-atmospheric parameters, marine fish production from the eighteen Northern Indian Ocean Rim Countries and group wise marine fish production from India.
- The study revealed that marine regime shifts have occurred during 1976/77, 1988/89 and 1998 as reported from other parts of the globe. In addition to these regime shifts, two additional regime shifts during 1970 and 1983 were also identified.
- Regime shifts have altered the production and distribution of some commercially important marine fishes (Indian oil sardine, mackerel and cat fishes) from Indian waters.
- From the present study it is found that regime shifts occur when one strong *El Nino* or *La Nina* event closely preceded or followed by a strong/weak *El Nino* or *La Nina* event.
- Status report on the possible impacts of climate change based on literature review submitted to National Network Coordinator.

FUNDING AGENCY **ICAR A.P. CESS**
PROJECT TITLE **National Risk Assessment Programme for Fish and Fish Products for Domestic and International Markets**
SCIENTISTS **D. Prema** and N. K. Sanil
CENTRE Cochin
COLLABORATING INSTITUTE CIFT, Cochin

During the period from April 2004 to March 2005 monthly samples of Green mussel (*Perna viridis*), Black clam (*Villorita cyprinoides)* and Edible oyster (*Crassostrea madrasensis*), water and sediment were collected from northern, central and southern zones of Kerala. Meat,


Nematode


Polydora sp.


Copepods


Pinnotherus sp.


Stegotricha sp.

Organisms of Phytosanitary significance recovered from bivalves

water and sediment from respective zones were processed and analysed for heavy metals. Bivalve meat samples were processed and sent to CIFT, Cochin for quantification of pesticides using Gas Chromatography. Every month 25 numbers of live bivalves from the three zones of Kerala were examined for parasites.

Salient results of the analysis:

- In bivalve meat samples the heavy metals, Cd (ND – 1.6ppm), Cr (ND- 6.1ppm), Pb (ND- 8.9ppm) and Zn (9.1ppm- 105.4ppm) were present.
- In water the concentration of heavy metals detected were, Cd (ND), Cr (ND- 10.6ppm), Pb (ND) and Zn (ND- 0.29ppm).
- In sediment the heavy metals, Cd (ND), Cr (26ppm- 119ppm), Pb (ND) and Zn (4ppm- 44ppm) were present.
- The parasites of sanitary significance were not recorded from bivalves so far examined.
- Parasites of phytosanitary significance recorded included ciliates of the genus *Trichodina* and *Stegotricha*, different types of nematodes, trematode metacercaria, pea crab and different species of copepods.
- Symbiotic/ commensal ciliates and shell damaging *Polydora* sp. were also recorded from the bivalves examined.

FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Cattle Feed Production from Selected Seaweeds of Indian Coasts**
SCIENTISTS	**P.Kaladharan,** S.N. Rai, Dinabandhu Sahoo
CENTRES	Cochin, Karnal and Delhi
COLLABORATING INSTITUTE	NDRI and Delhi University

- For cattle feed evaluation studies, *Gracilaria corticata* and *Ulva fasciata* are exploited from Thikkodi and Thangaserry in Kerala coast and species of *Sargassum*, *Turbinaria* and *Ulva lactuca* from Palk Bay in Tamilnadu.
- Dry samples of above seaweed species were sent to NDRI Karnal in March and in May 2005.
- Heavy metal profile done through AAS revealed safe levels in these seaweeds.
- Dry matter content in seaweeds and regeneration rate after successive harvests are the studies envisaged for the period ahead.

FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Development of Pro-active Disease Control Strategies for Sustainable Shrimp Farming using Marine Algal Metabolites**
SCIENTISTS	**A.P. Lipton**
CENTRE	Vizhinjam

- The water as well as methanol extracts of *Ulva fasciata* exhibited antibacterial activity against *Vibrio alginolyticus*.
- In the laboratory trials with *Penaeus monodon* PL20 larvae growth

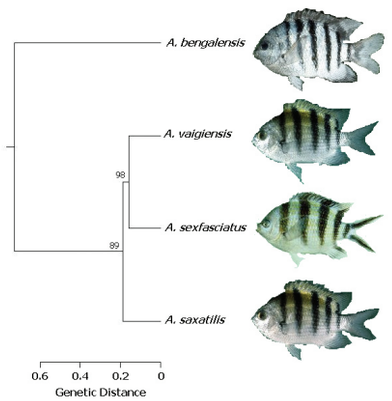
enhancement was noted in the methanolic extract fed group compared to the water extract and control groups.

- The shrimps in farm trial exhibited improved resistance to infections, better growth rate and survival.
- The laboratory and farm trials suggest the advantage of using marine bioactive metabolites isolated from *Ulva*, as a potent therapeutic and growth promoting agent.
- Marine secondary metabolites were isolated from shade-dried *Hypnea musciformis* using methanol as the solvent.
- Mortality of mosquito larvae (*Culex* sp.) was noted from 1.0% concentration of the extract.
- The anticoagulant activity studied using whole blood clotting time method using tilapia fish (*Oreochromis mossambicus*) indicated activity from 0.1% level onwards.
- Antifouling activity of secondary metabolite was evaluated using the "mollusc foot adherence bioassay". The common rock fouler, *Patella vulgata* was used as test organism.

  The immediate foot reflex and mobility were monitored continuously until the foot was completely shrunken. The regaining capacity was determined by comparing the number of snails, which spread their foot compared to the total snails initially introduced.
- Antibacterial activity was checked using the disc method. Antibiotic activity was noted from 0.1% concentration against *Serratia marscecens, Staphylococcus aureus, Vibrio alginolyticus, V. fischeri, Pseudomonas aeruginosa, Micrococcus luteus* and clown fish isolate *CLY16J04.*
- Brine shrimp cytotoxicity assay was performed using the freshly hatched free-swimming nauplii of *Aremia* sp which indicated activity from 0.01% conc.
- Rotifer toxicity test performed using cultured *Brachionus plicatilis* in 24 well plates indicated activity from 0.01% of the extract.
- *P. monodon* were fed with top coated *Hypnea* incorporated feed at the rate of 5-6% of body weight, three times daily, and bacterial challenge was made to detect the rate of bacterial clearance.
- Compared to the control group, significant bacterial clearance rate was detected in the hemolymph of shrimps fed with *Hypnea* incorporated feed.

FUNDING AGENCY	**ICAR A.P. CESS**
PROJECT TITLE	**Evaluation of Genetic Heterogeneity in Marine Ornamental Fishes Using Molecular Genetic Markers**
SCIENTISTS	**P. Jayasankar** and Boby Ignatius
CENTRES	Cochin and Mandapam

- Phylogenetic relationship among sergeant major species, *Abudefduf bengalensis*, *A. vaigiensis*, *A. saxatilis* and *A. sexfasciatus* was established using RAPD. *A. bengalensis* formed a distinct outgroup.



Phylogenetic relationship of sergeant major species as revealed by RAPD

- Microsatellites are excellent markers for studying genetic heterogeneity and parental inheritance in cultured fish. Experiments on cross-species amplification of microsatellite loci in clown fish were carried out; inheritance from parents to progeny was studied.
- Five pairs of primers designed on the reported microsatellite sequences from sergeant major, *Abudefduf luridus* were used to amplify gDNA of *Amphiprion sebae*.
- Cloned the locus AL10 129 in pDK 101 vector and sequenced bidirectionally using T-7 and SP6 promoter specific primers as well as an internal primer. Dinucleotide repeat $(GA)_{10}$ was present in the sequence.
- The microsatellite DNA sequence of *Amphiprion sebae* (AS 10, 129 bp size) was submitted to the GenBank (NCBI), which was released with the accession number **DQ079821**. The nucleotide sequence is given below:

1 tagtctaccc caggggagaa gcagagagag agagagagag agaggggaag acagaaagaa
61 ggagaaagag agggatggaa ggaggggggag aggcgaagac atgcagacag acaggagtgt
121 ggattatgg
//

FUNDING AGENCY	**Ministry of Environment and Forests**
PROJECT TITLE	**Studies on the Biology, Captive Spawning and Sea Ranching of the Seahorse, *Hippocampus* sp.**
SCIENTISTS	**A.P. Lipton**
CENTRE	Vizhinjam

- Sea horse species such as: *Hippocampus kellogi, H. kuda, H. fuscus, H. histrix, H. trimaculatus, H. spinosisimus, H. zebra* were recorded.
- The eggs of *H. kuda* were ovoid (2.12 ±0.019 mm long, 1.97 ± 0.045 mm wide) with numerous bright orange/ red fat globules. In laboratory, the male seahorse ejects a batch 3 to 8 young ones at a time usually in the morning hours and the mean number of juveniles per brood was 262.33± 59.49 (range 162 to 317).
- Mean length of immediately released juveniles were 7.83 ±0.35 mm and the wet weight was 1.17 ± 0.03 mg.
- Freshly hatched *Artemia* nauplii (610±10µm in length) were accepted as the best feed after 8 to 12 h of birth.
- A conical bottom rearing system (Fibre reinforced plastic) with mild aeration improved the survival of babies.
- After 90 days, juveniles attained a length of 101.10 mm and wet weight of 1.94 g.
- Under captive conditions, the laboratory reared 110 to 125 days old males released their first (F1) generation with a brood size of 30 to 65 normal babies.
- A total of 366 laboratory - reared baby seahorses *H. kuda* (average length: 106 ± 14.08 mm) were floy tagged and released at depths ranging from 5 to 6 m, comprising sea grass and soft coral beds off Puthupattinam and Mullimunai, along the Palk Bay (near Ramanathapuram) of Tamil Nadu.

PROJECT CODE	**DOD**
PROJECT TITLE	**Farming and Pearl Production in the Black Lip Pearl Oyster**
SCIENTISTS	**M. J. Modayil,** K.K. Appukuttan, K.S. Mohamed, T.S. Velayudhan, V. Kripa, S. Dharmaraj and I. Jagadis
CENTRE	Port Blair

- Project site was taken over from DOF, A& N Islands for development of Laboratories and Hatchery system.
- Oyster survey was organized from Havelock Island for broodstock collection using SCUBA and snorkeling.
- Broodstock kept in laboratory was induced to spawn using pH manipulation (using TRIS buffer) and more than 10 lakh D shaped larvae were produced.
- Implantation of 5 mm nucleus was done in 22 oysters, their survival and growth is being monitored. The instrument developed for the implantation of larger nucleus was tested in *P. margaritifera.*

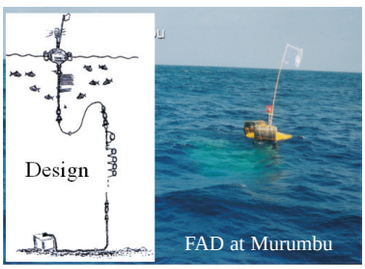
Nucleus implantation in *Pinctada margaritifera* and raft moored off Marine Hill in Port Blair for pearl oyster rearing

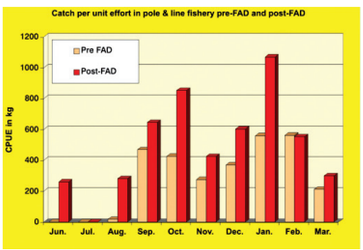
- A 5x5 m raft was deployed off Marine Hill for oyster rearing. A SBM raft was placed near Havelock Island Jetty for spat collection.
- Seawater intake, treatment and hatchery design was finalized.

National Agricultural Technology Projects

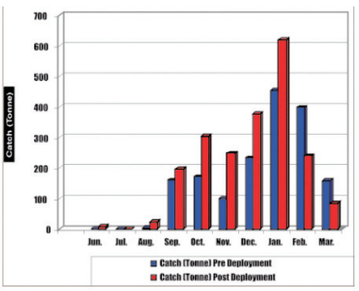
PROJECT CODE	**NATP/PSR**
PROJECT TITLE	**Augmentation of Marine Fish Production in Lakshadweep**
SCIENTISTS	**K.P. Said Koya,** K.S. Mohamed and M. Sivadas
CENTRE	Minicoy island

A. FAD for enhanced efficiency in tuna production



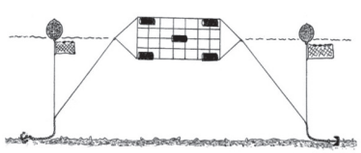


Temporary FAD

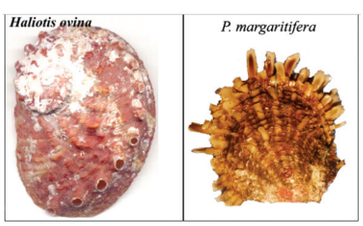


- Temporary FADs very effective for seer fishes, tunas, rainbow runners etc. Yielded 1.4 t worth Rs. 0.70 lakh of seer fishes alone in three months.
- Convinced of the effectiveness, Lakshadweep Administration has decided to deploy 40 FADs in entire Lakshadweep.
- Organized Training Workshop on FADs from 25- 26 November 2004. 72 fishermen, *Kelus*, *Moopens* etc. participated.

B. Feasibility study of marine pearl culture in island ecosystem



- Perfected mooring technique using two drag resistant danforth anchors with 3-4 m iron chain.



- Recorded black lip oyster and pearl producing abalone from Lakshadweep waters for the first time.

- Organised Training Workshop on marine pearl culture from 30 Sept to 4 Oct 2004. 30 educated youths, 12 students and 6 NGOs participated.

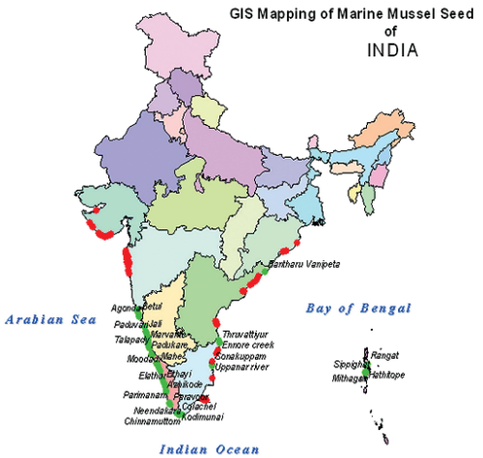
- 80-90 days gestation period produced very good images with 65 % recovery 15 % mortality and 20 % rejection.

PROJECT CODE	**NATP/MM**
PROJECT TITLE	**Integrated National Agricultural Resources Information System (INARIS)**
SCIENTISTS	**N.G.K. Pillai** and T.V. Sathianandan
CENTRES	Cochin (Co-operating Centre)

- Data entry has been completed in the project database by incorporating details of all Research Projects taken up at CMFRI and CIFT during the 8th and 9th Five-Year Plans.
- Created the database on Fisheries Technology and entered information regarding different technologies developed at CMFRI and CIFT to different tables in the database. JPEG images of farm sites, hatchery, species, harvesting and post harvest technologies etc. were incorporated into the database as OLE objects.
- Modified the structure of the database by incorporating species groups and species table and relating them in the ER diagram.
- Modified the species table by adding details about the groups and species codes.
- Updated the marine fish catch table with state wise production statistics from 1994 to 1998.
- In the export of seafood table, export of marine fish and fish products to different countries have been incorporated.
- A CD containing the entire database has been created as per the format and submitted to NBFGR, Lucknow.

PROJECT CODE	**NATP/ PSR**
PROJECT TITLE	**Mussel Mariculture**
SCIENTISTS	**T. S. Velayudhan,** V. Kripa, Anil Ranade, R. Soundararajan, K.K. Appukuttan, K. S. Mohamed, P. Laxmilatha, N. Ramachandran, Sujitha Thomas, Geetha Sasikumar, P. K. Asokan, R. Sarvesan and P. V. Sreenivasan
CENTRES	Cochin, Chennai and Mangalore

- For the first time, women fishers of Maharashtra have formed Self Help Groups for mussel farming (3 groups). Instruction manuals in English and Marathi were published.
- Mass awareness campaigns were organized. Horizontal expansions were done in Tamil Nadu, Pondicherry, Goa, Andhra Pradesh and Kerala.



Green markers in the map indicate high abundance of mussel seed whereas red markers indicate the absence of seed.

- New demonstrations on raft culture at Padanna and Thangassery were organized in the open sea and Bay respectively.
- Good growth and less fallout were observed in mussels seeded on 28 to 30 mm coir rope at Padanna.
- The huge waves of tsunami at Mavila, Kasargod area damaged the framework and arms of the floats attached to mussel culture rafts.
- Relaying of mussel spat was done at Kavanad from the cull-out fishery samples and natural stocks.
- GIS mapping of mussel seed resources and culture sites of India was completed.
- Film shooting on Mussel Mariculture for National Agricultural channel completed.
- Technology Information Forecasting and Assessment Council (TIFAC) approached CMFRI for technical assistance in popularizing mussel farming in Malabar area and their support for export oriented production. TIFAC officials interacted with mussel farmers of Kasargod district.
- A simple continuous flow through system for depuration was developed and demonstrated in the farm sites.

PROJECT CODE	**NATP/PSR**
PROJECT TITLE	**Breeding and Culture of Pearl Oysters and Production of Pearls**
SCIENTISTS	**K.K. Appukuttan,** K.S. Mohamed, V. Kripa, T.S. Velayudhan, D.C.V. Easterson, A.C.C. Victor, S. Dharmaraj, N. Ramachandran and M.K. Anil
CENTRES	Cochin, Tuticorin and Vizhinjam

- Studies were made on uptake by the pearl oysters of allochthonous metals into nacre in higher quantity so as to decisively influence the colour of the nacre. The safe level of chromogenic metals dosage suitable for administration was broadly estimated following LC_{50} methodology. In oysters exposed to 10 ppm $FeCl_3$ it took 48 h for iron to reach hepatopancreas and foot and 72 h to reach the mantle and muscle.
- In case of manganese too colour modification was observed, though of less intense nature, it was light orange to grayish orange. The results show that colour modification is possible with metal enrichment. Metal enrichment did not affect the lusture of pear. Copper gave rainbow coloured pearls. Cobalt did not yield colour modification and nacre deposition was absent.
- Technology for production of jewellery from Mabe pearl was standardized and a process flow chart was prepared. Production of large mabe pearls (15mm) was done successfully in *P. fucata*. The mabe were embedded in silver for making pendent and rings.
- Comparative studies of growth and biometric relationships of pearl oyster *P. fucata* (Gould) transplanted from the Tuticorin Bay in the Gulf of Mannar along the Indian southeast coast to Kollam Bay in the Arabian Sea, south west coast of India were made and results

showed that growth in terms of DVM, HL and THK was double in Kollam Bay as compared to South East Coast.

- A documentary film on the achievements of the project entitled, *Farming Jewels from the Sea* of 15 min duration in 3 languages was produced.

Table. DVM, HL, THK and TWT of different stocks (KS - Kollam stock; TSK - Tuticorin stock at Kollam; TST - Tuticorin stock at Tuticorin) after 6 months and 1 year of growth (all length measurements in mm and weight in g)

Period	Stock	DVM	HL	THK	TWT
After 6 months	KS (progeny stock)	45.68	39.00	15.96	13.65
	TSK (transplanted stock)	55.01	45.22	19.09	20.82
	TST(parent stock)	41.31	37.18	13.77	8.99
After 12	KS	62.46	53.64	26.52	46.10
months	TSK	69.80	55.17	26.98	56.94
	TST	43.90	40.88	16.78	15.96

Mabe pearl embedded in silver as rings and pendant

PROJECT CODE NATP/CGP
PROJECT TITLE **Development of a National Referral laboratory for Marine fish and shell fish Microbial diseases**
SCIENTISTS **K.C. George,** P. C. Thomas, N.K. Sanil and K.S. Sobhana
CENTRES Cochin

- The project was completed and completion report submitted.
- Established a National Referral Laboratory with facilities for isolation and identification of fish and shellfish microbial pathogens and their maintenance. The laboratory has facility for histopathological, and serological identification of bacterial pathogens.
- The laboratory has a collection of bacterial strains isolated from grouper, pearl spot, clown fish, damsel fish, shrimps, lobster and oyster.
- Histological documentation of diseased fish and shellfish organs and tissues has been done.
- DNA profile of *Vibrio parahaemolyticus* isolated from shrimp has been determined.

PROJECT CODE NATP
PROJECT TITLE **Institution-Village-Linkage-Programme (IVLP) for Technology Assessment and Refinement (TAR) in the coastal agro ecosystem of Ernakulam in Kerala**
SCIENTISTS **R.Sathiadhas,** L.Krishnan, C. Ramachandran, Vipinkumar.V.P and P.K.Martin Thompson.
CENTRES Cochin

The IVLP has been operational at *Elamkunnapuzha* Village of *Vypeen* Island in Ernakulam District of Kerala for the last 3 years. A total of 687 farm families were involved in the project as participant stakeholders

covering a population of 3435. Altogether, 31 techno interventions were implemented (13 in fisheries, 13 in agri-horticulture, and 5in livestock) and 15 training programmes were organized for 576 farmers. The linkages developed in this programme enabled the stakeholders to sustain and continue their efforts. The impact of this programme has been highly appreciated and acclaimed and is now popularly known as " *Elamkunnappuzha* model of development".

IVLP family during fish harvest

The experiments at *Elamkunnappuzha* proved that the average yield of *Mugil cephalus* is 4,050 kg / ha and that of *Chanos chanos* is 5,500 kg / ha with an average farm- gate price of Rs 115 / kg and Rs 70 / kg respectively. If 20,000 ha of potential area of Kerala is brought under monoculture and polyculture of fin fishes in a time span of 10 years, an additional production of 60,000 tonnes could be attained, fetching a surplus revenue of about Rs 420 crore per annum even if an average production of 3 t/ ha with an average price of Rs 70 / kg is anticipated.

In the last phase, emphasis was given for prioritisation of the refined technologies and the following six techno- interventions were selected for horizontal expansion in the state of Kerala.

1. Monoculture of grey mullet
2. Monoculture of milkfish
3. Polyculture of finfish
4. INM in coconut plantations
5. Dairy farming with *para* grass
6. Poultry farming with the "*Gramalakshmi"* breed

The projected economic impact for these six technologies, at 25 % level of adoption in Kerala state alone was worked out as Rs.420 crore from an additional production of 60000 t of fish, Rs 220 crore from a surplus milk yield of 1000 t per day, an additional revenue of Rs 12 crore from poultry, and Rs 190 crore from coconut plantations in coastal districts.

PROJECT CODE	**NATP**
PROJECT TITLE	**Establishment of Agricultural Technology Information Centre**
SCIENTISTS	**R.Sathiadhas** and Vipinkumar.V.P
CENTRES	Cochin

Visit of Deputy Director of Fisheries, Tamil Nadu in ATIC

The Agricultural Technology Information Centre (ATIC) of CMFRI was fully functional and all the sales/services/products were channeled through the Single Window Delivery system. The well-designed museum in the centre was revamped totally with chronological depiction of Resources, Technology, Products and Services and trilingual write ups, which are self-explanatory. The important specimens and models of marine fishes and gears both traditional and modern were displayed. The sound proof Audio Visual laboratory equipped with all latest audiovisual equipments and projective devices is used for projecting educational movies for the visitors of different categories. Now ATIC has a vast collection of more than 50 different movies on fishery based technologies. The auditorium and museum in ATIC were well furnished with latest posters and charts thematically depicting various technological breakthroughs in mariculture.

- A total of 5029 farmers/ fishermen/ entrepreneurs visited and

interacted with the ATIC during the period under report.

- Sale of products/services had benefited 3,147 farmers.
- Diagnostic services and laboratory tests of samples brought by farmers generated an annual revenue of Rs 94,386/-.
- Sale of value added fish products, publications and technological inputs generated an income of Rs 23,975/- (Total revenue generated was 1,18, 361/-).
- Three pamphlets entitled 'Marine Pollution', Seaweed Recipes' and 'Marine Ornamental Fishes' and their Hindi versions such as '*Samudri Pradushan', 'Samudri Shaival Samvardhan' and 'Samudru ki alamkari machaliyam'* were released in a function where Dr.P.V. Deharai, the former DDG, Fisheries was the chief guest.
- A separate sales counter is functioning intensively, which helps the fisherfolk to directly get Value added products, Ornamental Fish Feed, Fresh shrimp and dry fish products inturn serving as a boon to entrepreneurial fisherfolk, students and other innumerable visitors.
- The ATIC web site www.aticcmfri.org was updated with renewed domains.

Visit of Shri P.M. Hakkim. IAS, Secretary, Animal Husbandry & Fisheries, ICAR

Visit of Governor of Haryana to ATIC

FUNDING AGENCY	**NATP (CGP)**
PROJECT TITLE	**Broodstock Development, Breeding, Hatchery Production and Restocking of Mud Crabs**
SCIENTISTS	**E.V.Radhakrishnan** and Mary K. Manisseri
CENTRES	Cochin

- NATP (CGP) Project "Broodstock development, breeding and hatchery production of mud crabs" was completed in May 2004 and completition report submitted.
- Technique for mass production of the mud crab *Scylla serrata* (Keenan, 1998) seeds was developed. Protocols for broodstock selection, breeding, stocking, food and feeding, water quality management and nursery rearing were standardized. Cannibalism in megalopa stage and early crablets reduced by providing substrate and appropriate hatchery management procedures. Obtained 12- 15% survival from zoea to crablets in different experiments.

PROJECT CODE	**NATP**
PROJECT TITLE	**Designing and Validation of Communication Strategies for Responsible/Sustainable Fisheries : A Co -Learning Approach**
SCIENTISTS	**C.Ramchandran,** S.Ashaletha, Vipinkumar.V.P and R.Narayana Kumar.
CENTRES	Cochin

- The project achieved all its objectives successfully and was closed in October 2004. The completion report was submitted to PIU, NATP, New Delhi.
- The notable achievement of the project during the extended period (2004-5) has been the development of the animation film "Little Fish

Responsible Fisheries Extension Module

and tiny Net" in all the maritime vernaculars of the country, Viz., Hindi, Gujarati, Marathi, Kannada, Malayalam, Tamil, Telugu, Oriya, and Bengali in addition to the English. This is the first of its kind in the country. The new film titled "The Greedy fish Farmer" in Hindi and English deals with the issue of excessive use of chemicals in aqua/mari culture.

- An illustrated fisher-friendly publication in Hindi titled "Sagar Sada Bahar" has been brought out. This explains the concept of responsible fisheries in a very simple fashion.
- Two books in English titled ."Teaching Not to Fi(ni)sh-A constructivist perspective on reinventing a responsible marine fisheries extension system" and **"**On designing communication tools for responsible fisheries" respectively were also brought out.
- The Responsible Fisheries Extension Module (RFEM) consisting of 13 communication tools and 6 strategies have been designed and validated. The components of the module are given in Table.

Components of the Responsible Fisheries Extension Module (RFEM)

No	Medium	Title/Content
1.	Book in Malayalam	FAO Code of Conduct for Responsible fisheries (FAO CCRF)
2.	Illustrated book in Malayalam	What, Why and How of the FAO CCRF
3.	Illustrated book in Hindi	"Sagar Sada Bahar" ('Ever green seas')
4.	Illustrated brochure in Malayalam	The need for responsible fisheries
5.	Animation Film in 10 Indian languages	"Little fish and tiny Net" (English, Malayalam, Hindi, Tamil, Telugu, Oriya, Bengali, Kannada, Marathi and Gujarathi)
6.	Animation Film	'The Greedy fish farmer'
7.	Video film (English)	"Colourful Voices for Responsible Fisheries "
8.	Video film	Kadakkodis of Malabar coast
9.	Participatory painting	Responsible fisheries
10.	Book in English	1."Teaching Not to Fi(ni)sh-A constructivist perspective on reinventing a responsible marine fisheries extension system"
		2. "On designing communication tools for responsible fisheries"
11.	Campaign materials	1.T-Shirt with the message "Save the seas first and catch fish next" on the front and "Fish for all for ever, Let us practice responsible fisheries " in the back
		2. Wall hanger with message

PROJECT CODE	**WorldFish Center, Penang, Malaysia**
PROJECT TITLE	**Strategies and Options for Increasing and Sustaining Fisheries and Aquaculture Production to Benefit Poor Household in Asia (ADB-RETA 5945)**
SCIENTISTS	**N.G.K. Pillai**
CENTRES	CMFRI, Cochin (Co-operating Centre)

- Catalogued the existing and pipeline mariculture technologies, fishing practices and post-harvest technologies in India. The documented technologies were prioritized to help the rural poor in poverty alleviation and the final report on Component-I "Aquaculture Technologies and Fishing Practices in India" was submitted to the WorldFish Center, Penang. The report was presented and discussed in a National Workshop conducted on 29th & 30th January 2004 at NCAP, New Delhi. Suggestions/recommendations made by the experts in the workshop were incorporated and finalized the report. A paper entitled 'Marine fishing practices and coastal aquaculture technologies in India' has been published. The book is an effort to consolidate and comprehensively presently fisheries research and development under the following major heads:

i) evolution of fisheries research and development.

ii) magnitude of fishery and aquaculture potential over space and their contribution in fish production over time.

iii) advancements in fisheries and aquaculture technologies, their adoption and impact over time and space.

iv) prioritization, future prospects and potential production of different technologies.

Technology Assessed & Transferred

At Dalavapuram (Ashtamudi Lake) "Bouchot" culture of mussel was carried out and a production of 12kg/m was achieved in 3months

Cultchless adult produced at Kozhikode

A working prototype design was developed for de-roping harvested mussels. A manually operated unit for removing the mussels from the rope during harvest was fabricated. The unit with a wooden ramp of height 75cm, a cylindrical winding drum and a separator was fabricated and field-tested. It was possible to separate the mussels without damage at the rate of 20 mussel ropes/hour

- Mussel and oyster production showed an increase from 1600 tonnes to 4500 tonnes and 450 tonnes to 800 t respectively.
- Experimental 'Bouchot' culture of mussel gave a production of 12kg/m within three months.
- A prototype for de-roping mussels from the harvested rope was developed.
- A simple method of producing cultchless spat of edible oyster has been developed.

EDUCATION & TRAINING

Post Graduate Programme In Mariculture

Ph. D. Programme

The following regular students (11) and Senior Research Fellows of the Institute have been awarded Ph. D. Degree during the year.

Central Institute of Fisheries Education (Deemed University)

- Mr. Sabu, A.S., for his thesis entitled " Some aspects on ecotoxicology and ecophysiology of the shrimp *Penaeus semisulcatus* (de Haan 1844) to copper, cadmium and zinc" under the guidance of Dr. P. Nammalwar, Principal Scientist (Retd.), Madras RC of CMFRI.
- Mr. Salin K.R., for his thesis entitled "Reproductive biology and larval rearing of *Hippocampus kuda*, and the taxonomy of sea horses (*Hippocampus* spp.) along the southern coast of India" under the guidance of T.M. Yohannan, Principal Scientist (Retd.), Calicut RC of CMFRI.
- Ms. Leena Joseph for her thesis entitled "Studies of the near shore coastal waters off Mumbai with reference to pollution and Fisheries" under the guidance of Dr. V.V. Singh, Senior Scientist, Mumbai RC of CMFRI.
- Ms. Anitha, P.S, for her thesis entitled "Studies on certain selected live feed organisms used in aquaculture with special reference to rotifers (Family: *Brachionidae*)" under the guidance of Dr. Rani Mary George, Principal Scientist, Madras RC of CMFRI.
- Ms. Leena, K., for her thesis "Reproductive dynamics of *Metapenaeus affinis* in Mumbai waters under the guidance of Dr.V.D. Deshmukh, Principal Scientist, Mumbai RC of CMFRI.
- Mr. Binu Varghese, for his thesis entitled "Nutritional studies on Sebae Anemone fish, *Amphiprion sebae* Bleeker 1853, with special reference to protein and lipid requirements" under the guidance of Dr. R. Paul Raj, Head of PNP Division.
- Mr. Anikuttan, K.K., for his thesis entitled "Pathology of aflatoxicosis and heavy metal toxicity in pearl spot, *Etroplus suratensis* (Bloch)" under the guidance of Dr.K.C. George, Principal Scientist.

University of Kerala

- Mr. Satish Sahayak, SRF, for his thesis entitled " Studies on the taxonomy and some aspects of biology of the fishes of the family Balistidae from the Indian seas" under the guidance of Dr. V.S.R. Murty, Principal Scientist (Retd.).

Cochin University of Science & Technology

- Mr. Gireesh, R, SRF for his thesis entitled "Algal nutritional requirements of larvae of *Paphia malabarica"* under the guidance of Dr. C.P. Gopinathan, Principal Scientist.
- Ms. Ajitha, SRF for her thesis entitled "Role of *Bacillus* and *Lactobacillus* from marine environment for sustainable aquaculture practices" under the guidance of Dr. (Mrs.) V. Chandrika, Principal Scientist.

- Mr. S.D. Gopakumar, SRF for the thesis entitled " Nutritional enrichment of the rotifer *Brachionus rotundiformis* (Tsehuguoff) for the rearing of marine finfish and shrimp larvae" under the guidance of Dr. C.P. Gopinathan, Principal Scientist.
- Five more students and SRFs in Sponsored projects have submitted their Ph. D. theses for adjudication and the results are awaited.
- Two students who have joined the Ph.D. (MC) 2004-2007, batch programme in October, 2004 are undergoing the First Semester Course Work.

M.F. Sc. Programme

- Five students of 2002-2004 batch have successfully completed their final semester in August, 2004 and left the Institute.
- Five students of 2004-2006 batch have joined the programme at this Institute for the 2nd semester course programme after undergoing their first Semester at CIFE (DU), in March, 2005.

Krishi Vigyan Kendra

Krishi Vigyan Kendra (KVK) is an innovative science based institution which functions on the principles of collaborative participation of subject matter experts, extension workers and farmers under the operational control of CMFRI. The KVKs create awareness and motivate farmers for adopting modern technologies by conducting regular on and off campus training programmes, undertaking on farm testing, frontline demonstrations and providing farm advisory services. The cardinal principle in all the training activities is "learning by doing" and imparting skill oriented training.

1. Training programmes conducted:

a. Practicing farmers (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Agriculture	Jasmine cultivation	1	-	20	20	1
	Coconut cultivation	1	10	10	20	21
TOTAL (a)		2	10	30	40	21

b. Practicing farmers (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Shrimp farming	5	86	12	98	13
	Crab farming and fattening	5	76	14	90	13
Agriculture	Jasmine cultivation	9	80	100	180	7
	Vegetable cultivation	1	20	-	20	-
	Use of bio fertilizer	1	19	1	20	-
	Banana cultivation	1	19	1	20	-
	Balanced fertilization and integrated nutrient management	1	35	1	36	-
TOTAL(b)		23	335	129	464	33

c. Rural Youth (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Agriculture	Mushroom cultivation	5	21	7	20	3
	Jasmine cultivation	1	1			
Home Science	Preparation shrimp cutlet	1	-	11	11	2
	Preparation of Fish pickle	1	-	10	10	2
	Value addition to mushroom	1	2	26	28	1
	Preparation of shrimp wafer	1	-	20	20	4
TOTAL (c)		10	24	163	187	15

d. Rural Youth (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Crab farming and fattening	2	19	21	40	1
	Fresh water ornamental fish culture	11	168	55	223	1
	Fresh water fish farming	3	52	8	60	-
Agriculture	Mushroom cultivation	12	38	212	250	16
	Vermi composting	4	20	51	71	12
	Jasmine cultivation	4	7	75	82	1
Home Science	Preparation of dishwashing powder	2	-	35	35	17
	Preparation of toilet soap	3	-	60	60	2
	Preparation of clam pickle	2	-	40	40	1
	Preparation of jackfruit jam	1	-	20	20	-
	Preparation of shrimp pickle	6	-	128	128	26
	Preparation of garlic pickle	1	-	15	15	3
	Preparation of mango jam	1	-	40	40	9
	Preparation of pine apple squash	3	-	60	60	17
	Preparation of Shrimp cutlet	1	-	20	20	19
	Preparation of mixed fruit jam	4	-	80	80	8
	Value addition to mushroom	1	9	22	31	-
	Preparation of quail egg pickle	1	-	20	20	-
TOTAL (d)		62	313	962	1275	133

e. Extension workers

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Crab farming and fattening	3	25	26	51	-
Agriculture	Organic farming and its field application	1	13	17	30	-
	Mushroom cultivation	1	7	20	27	-
	Intercrop in coconut farm	1	20	10	30	2
	Seed production technology	1	7	23	30	-
Home Science	Preparation of shrimp pickle	1	-	20	20	1
	Value addition to fruits	1	3	17	20	3
TOTAL (e)		9	75	133	208	6
GRAND TOTAL (a+ b+ c+ d+ e)		106	757	1417	2174	208

Smt M. Sreedevi, Assistant Director of Agriculture inaugurating the Field day in connection with Farmer's Field School

2. Conduct of Farmer's Field School (FFS)

A sponsored training programme funded by the Central Integrated Pest Management Centre, Ministry of Agriculture, Government of India, Kochi on "Integrated pest management in coconut" was organised. Nine weekly sessions and a field day were conducted from 20-1-2004 to 11-3-2005. Thirty farmers and 5 Agricultural Officers of the State Department of Agriculture attended the training programme.

3. Conduct of Science camp for school students

Two Science camps were organised for the Vocational Higher Secondary students of Government High School, Narakkal. One was on "Aqua farming" and the other was on "Value addition to shrimp and fish"

Demonstration on preparation of value added products from shrimp and fish during Science camp for school students

4. Conducting Seminars /Mahila meet /Farmers meet etc

Sl.No.	Date	Nature of activity	Place
1.	15-5-2004	Farmers meet on Vanilla cultivation	Karthedam Cooperative bank Auditorium, Malipuram
2.	17-5-2004	Field day on Integrated feed management in shrimp farm	Field of Shri M.M. Asraf, Nettoor
3.	5-6-2004	World environmental day celebration	KVK, CMFRI campus, Narakkal
4.	1-7-2004	Mahila meet on “Empowerment of rural women”	Gramma panchayat, Kunnathunad
5.	5-7-2004	Field day on "Pheromone trap for Red palm weevil in coconut farm"	Farm of Shri V.T. Joseph, Variyath, Elamkunnapuzha
6.	17-8-2004	Farmer meet on Fresh water ornamental fish culture	Gramma panchayat, Kadayirupu
7.	17-8-2004	Farmer meet on Jasmine cultivation	Gramma panchayat, Edavanakad
8.	18-8-2004	Farmers meet on Jasmine cultivation	Gramma panchayat, Kunnathunad
9.	6-11-2004	Farmers meet on Shrimp farming	Gramma panchayat, Kandakadavu
10.	30-11-2004	Farmers meet on Shrimp farming	Gramma panchayat, Moolampilly
11.	7-12-2004	Mahila meet on “Empowerment of rural women”	Satar Island, Moothakunnam
12.	8-12-2004	Farmers meet on Vermi composting	Krishi Bhavan, Nayarambalam
13.	17-12-2004	Farmers meet on Mushroom cultivation	Krishi Bhavan, Choornikara
14.	23-12-2004	Farmers meet on Mushroom cultivation	Krishi Bhavan, Vengola
15.	15-2-2005	Farmers meet on Vermi composting	Mamala Service Co operative hall, Thiruvaniyoor
16.	11-3-2005	Field day on Integrated pest management in coconut	KVK, CMFRI campus, Narakkal

Planting of mangroves in connection with World Environmental day

Pheromone trap in coconut farm for red palm weevil

Extension activities

5.1 **Front line demonstration (FLD)**

FLD on the following interventions were implemented during the period under report namely i. Rearing fresh water ornamental fishes; ii. Integrated nutrient management in coconut and iii. Preparation of value added product from shrimp- wafer.

5.2 **On farm testing (OFT)**

OFT on the following interventions were implemented during the period under report namely i. Integrated feed management in shrimp farm; ii. Recycling of organic wastes (farm resources) using earth worm and iii. Testing and refining preparation of cleaning powder; and iv. Testing and refining value added product from shrimp- pickle.

6. Establishment of income generating unit

6.1 Based on the training received in "Jasmine cultivation", Smt. Rosily Justin, Maliakkal, Edavanakad started Jasmine cultivation in 180 pots as terrace cultivation.

An average monthly production of 15 kg of flowers is obtained and is able to generate a income of Rs 2000/- per month.

6.2 Training and technical guidance in mushroom spawn production was given to Shri Sony Paul, Parambath House, Thiruvaniyoor. A small scale unit has been started by him for the production of milky mushroom spawn for the establishment of milky mushroom production.

6.3 Training and technical guidance was given to the member of the Dharsana Kudumbhashree unit, Ayyampilly in the preparation of shrimp pickle. A small scale unit has been established by them. The product prepared by this unitwas kept for sale at the district kudumbhashree trade fair at Ernakulam during 25-2-2005 to 2-3-2005.

7. Project feasibility report

Jasmine cultivation as self employment for Smt Rosily Justin

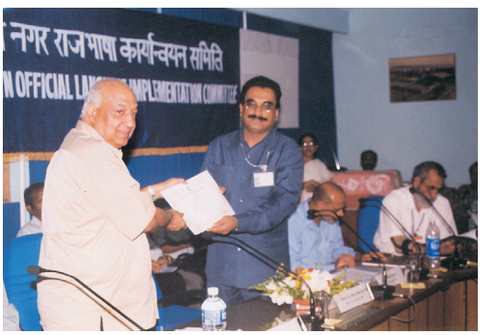
7.1 A project feasibility report on "Milky mushroom cultivation" (5kg/day) was prepared and given to Shri Sony Paul, Parambath house, Thiruvaniyoor.

7.2 A project feasibility report on "Milky mushroom cultivation" was prepared and given to the Agricultural Officer, Krishi Bhavan, Edavanakad for the implementation of the scheme on Mushroom cultivation by the Department of Agriculture, Kerala.

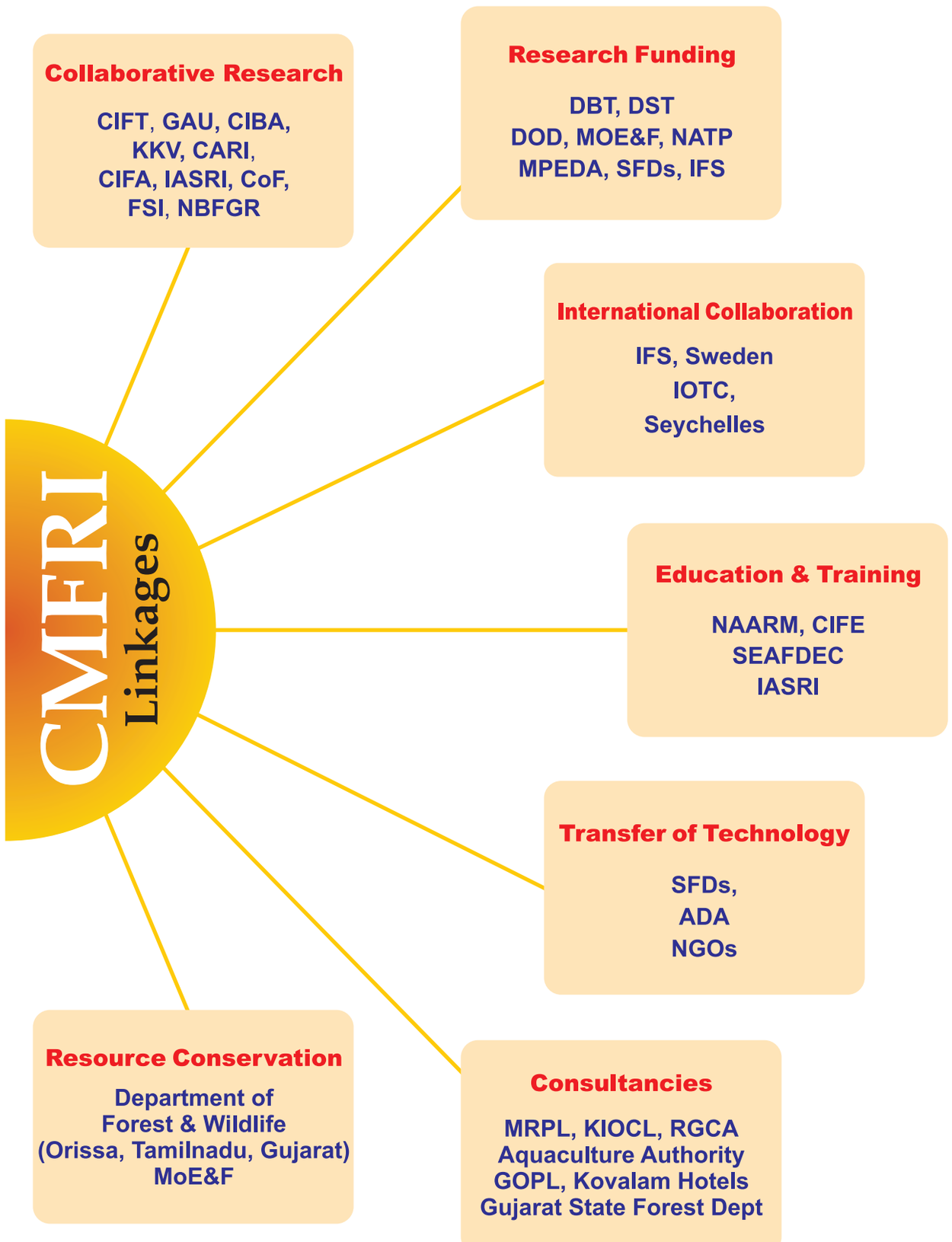
7.3 A project feasibility report on "Milky mushroom cultivation" was prepared and given to the Agricultural Officer, Krishi Bhavan, Asamanoor for the implementation of the scheme on Mushroom cultivation by the Department of Agriculture, Kerala.

Awards & Recognitions

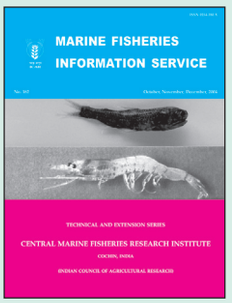
- Merit Certificate from Kochi TOLIC for topping in the purchase of Hindi books and coordinating the orders on purchase.
- **Dr. P.U. Zacharia,** Scientist SG had been awarded Ph.D Degree for the thesis **"**Studies on the fishery, biology and population dynamics of the whitefish *Lactarius lactarius* (Bloch& Schneider, 1801) along Karnataka coast" by the Karnataka University.
- **Dr. J. Selvin** was awarded the **JAWAHARLAL NEHRU AWARD FOR OUT-STANDING POST-GRADUATE AGRICULTURAL RESEARCH 2003' by the Indian Council of Agricultural Research** for his significant research contribution towards the solution of bacterial disease in aquaculture. Dr. Selvin worked under the supervision of Dr. A.P. Lipton, Principal Scientist, PNPD, CMFRI, Vizhinjam Centre.
- **Ms. Annie Selva Sonia,** PGPM student has been awarded **the Dr. Hiralal Chaudhari Gold Medal** for the year 2002-2004 for securing First Rank in M.F.Sc. Mariculture by the Central Institute of Fisheries Education (Deemed University).
- **Dr. Soumya Haldar,** former SRF, NATP Nutrition and Pathology in Mariculture has been awarded **Monbusho – Japanese Government Scholarship** for Post-Doctoral Research at Osaka University.
- **Dr. R. Paul Raj,** Head of PNPD and Principal Investigator of the NATP sub project 'Nutrition and Pathology in Mariculture' along with his team comprising of CCPIs, Dr.P.G.Viswanathan Nair (CIFT, Kochi), Rema Madhu (CARI, Port Blair) and G. Indra Jasmine (FC&RI, Thoothukudi) were awarded **Commendation Certificates** in the poster presentation held in connection with the National Symposium on Enhancing Productivity and Sustainability in Coastal Agro Ecosystem 'organized by Agro Ecosystem Directorate (Coastal) at CTCRI, Thiruvananthapuram during 9-11 June 2004.
- **Dr. P. Jayasankar,** Senior scientist won **I Prize** in **classical music** and **light music** in Kalasangamam organized by the Central Government Employees Welfare and Coordination Committee.
- **Dr. P. Jayasankar,** Senior scientist won **II Prize in light music** at the Joint Hindi Week celebration of Cochin TOLIC held during 13-17 December 2004.
- **Dr. Imelda Joseph** won **First prizes in English extempore and English poetry** writing competitions in Kalasangamam organized by the Central Government Employees Welfare and Coordination Committee.
- **Dr. Imelda Joseph** won II prize in **Hindi Message** sending competition conducted during Institute Hindi Week celebrations in 2004.
- **Shri G.S.Bhat**, Sr.Technical Assistant has won First prize in Hindi Grammar and Second prize in Hindi Quiz competitions held by the Mangalore TOLIC during Hindi Month celebrations.

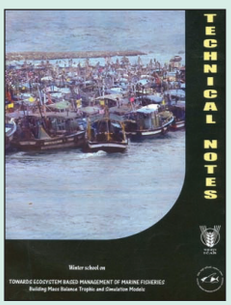


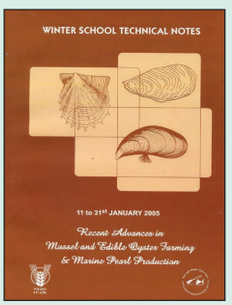
Prof. (Dr.) M.J. Modayil, Director receiving the TOLIC merit certificate for topping in the purchase of Hindi books from B.M. Jindel, Chief Commissioner of Income Tax

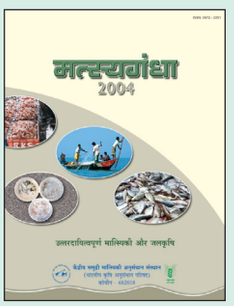

CMFRI
Linkages
Collaborative Research
CIFT, GAU, CIBA,
KKV, CARI,
CIFA, IASRI, CoF,
FSI, NBFGR
Research Funding
DBT, DST
DOD, MOE&F, NATP
MPEDA, SFDs, IFS
International Collaboration
IFS, Sweden
IOTC,
Seychelles
Education & Training
NAARM, CIFE
SEAFDEC
IASRI
Transfer of Technology
SFDs,
ADA
NGOs
Consultancies
MRPL, KIOCL, RGCA
Aquaculture Authority
GOPL, Kovalam Hotels
Gujarat State Forest Dept
Resource Conservation
Department of
Forest & Wildlife
(Orissa, Tamilnadu, Gujarat)
MoE&F

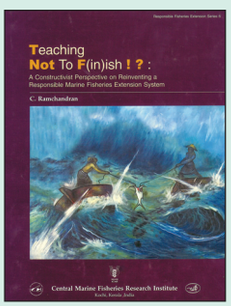
Publications

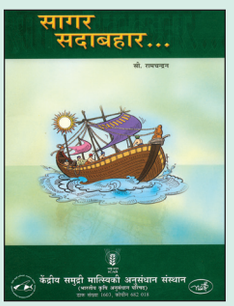


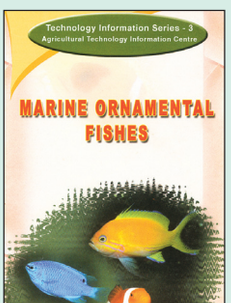












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- **Marine Fisheries Information Service - Technical and Extension Series**
- **CMFRI Newsletter**
- **Winter School on Ecosystem Based Managment**
- **Winter School on Bivalves**
- **Matsyagandha** - CMFRI special publication
- **Teaching Not To F(in)ish!?**
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Approved Ongoing Projects

In-house Projects

SL. NO.	Project Code No.	Title of the Project
FISHERY RESOURCES ASSESSMENT DIVISION		
1	FRA/ASSESS/01	Assessment of exploited marine fishery resources
2	FRA/ASSESS/02	Stock assessment techniques for exploited marine fish and shellfish resources
3	FRA/MOD/03	Application of stimulation models for marine fisheries management game
PELAGIC FISHERIES DIVISION		
4	PEL/CAP/1	Development of management strategies for sustainable fishery of Sardines (*Sardinella* spp.)
5	PEL/CAP/2	Development of management strategies for judicious harvesting of anchovies
6	PEL/CAP/3	Development of strategies for rational exploitation of seerfishes
7	PEL/CAP/4	Development of strategies for sustainable exploitation of tuna and billfish resources of Indian EEZ
8	PEL/CAP/5	Development of management strategies and options for sustainable harvest of mackerels
9	PEL/CAP/6	Development of management strategies and options for sustainable fishery of Bombay duck
10	PEL/CAP/7	Monitoring of fishery and resource characteristics of exploited ribbonfish stocks and their management along the Indian coast
11	PEL/CAP/8	Management of carangid resources of Indian EEZ
12	PEL/BIOD/01	Taxonomy of marine pelagic finfishes
DEMERSAL FISHERIES DIVISION		
13	DEM/CAP/01	Fishery and biological characteristics of the exploited stocks of elasmobranchs
14	DEM/CAP/02	Fishery and biological characteristics of exploited resources of groupers, snappers, breams and catfishes
15	DEM/CAP/03	Characteristics of exploited stocks of threadfin breams and silverbellies
16	DEM/CAP/04	Fishery and biological characteristics of exploited stocks of croakers
17	DEM/CAP/05	Biology and stock assessment of lizard fishes, bulls eye, pomfrets and threadfin resources
18	DEM/CAP/06	Biology and fishery of flatfishes, flatheads, goatfishes and whitefish
19	DEM/BIOD/01	Taxonomy of demersal fishes of India
20	DEM/CUL/01	Marine finfish culture
CRUSTACEAN FISHERIES DIVISION		
21	CRU/CAP/01	Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks
22	CRU/CAP/02	Stock assessment and management of non-penaeid shrimp resources of India
23	CRU/CAP/03	Investigations on the resource characteristics and development of management strategies for lobsters and crabs
24	CRU/CAP/04	Taxonomy of important crustacean
25	CRU/CUL/01	Broodstock development, selective breeding and restocking of marine shrimps
26	CRU/CUL/02	Breeding and seed production of lobster and crabs
27	CRU/CUL/03	Organic farming of *P. semisulcatus*
MOLLUSCAN FISHERIES DIVISION		
28	MOL/CAP/01	Fishery and biological characteristics of exploited cephalopod resources
29	MOL/CAP/02	Assessment of bivalve and gastropod resources
30	MOL/CUL/01	Technological feasibility studies and upgradation of molluscan mariculture
31	MOL/CUL/02	Selective breeding of pearl oyster *Pinctada fucata* (Gould)
32	MOL/CUL/03	Technological upgradation of molluscan seed production

33	MOL/CUL/04	Marine pearl production through tissue culture
34	MOL/BIOD/01	Taxonomy of marine molluscs

FISHERY ENVIRONMENT MANAGEMENT DIVISION

35	FEM/01	Monitoring the environmental characteristics of the inshore waters in relation to fisheries
36	FEM/02	Monitoring environmental contaminants from coastal waters with reference to bioaccumulation and biomagnipulation in fishes.
37	FEM/03	Culture of seaweeds
38	FEM/04	Development of strategies for sea turtle and sea cucumber conservation
39	FEM/05	Mariculture of live feed organisms
40	FEM/06	Taxonomy of marine zooplankton
41	FEM/07	GIS based atlas on potential mariculture sites along the Indian coast

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

42	PNP/NUT/01	Development of cost- effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions
43	PNP/PAT/01	Disease monitoring and management in mariculture
44	PNP/BIOT/01	Development of molecular and immuno- diagnostic kits for marine finfish and shellfish pathogens
45	PNP/BIOT/02	Cryo-preservation of marine fish spermatozoa
46	PNP/GEN/01	Population genetic studies in threadfin breams and sardines
47	PNP/PHY/01	Development of cost effective low-stress methods for live transport of fish and crustaceans

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

48	SEE/PMS/01	Price behaviour and marketing system of marine fisheries in India
49	SEE/ECO/01	Economics of marine fishing operations
50	SEE/ITK/01	Indigenous knowledge systems and community based resource management in marine fisheries
51	SEE/TOT/02	Livelihood analysis of coastal fisherfolk for technological empowerment

Sponsored Projects (National)

SL. NO.	Project Code No.	Title of the Project
1.	ERP/REV/01	Production of agar and sodium alginate from the sea weeds of Gulf of Mannar and Palk Bay
2.	ERP/REV/02	Commercial production of cultured pearls adopting onshore culture technology
3.	ERP/APC/14	Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers
4.	ERP/APC/15	Investigations on reproductive dynamics of penaeid prawns in Mumbai
5.	ERP/APC/16	Increasing fish production through artificial fish habitats
6.	ERP/APC/18	Development of sea farming technology for the whelk *Babylonia* spp.
7.	ERP/DOD/05	Investigations on the toxic algal blooms in the EEZ of India
8.	ERP/DOD/07	Development of acoustic techniques for fish and DSL biomass estimation
9.	ERP/DOD/08	Investigations on the effect of bottom trawling on the benthic fauna off Mangalore coast
10.	ERP/KFD/03	Development of artificial reefs along the Kerala coast (Kannur)
11.	ERP/MEF/04	Studies on the biology, captive spawning and sea ranching of the sea horse
12.	ERP/MPD/04	Participatory Management and conservation of lobster resources along the south west coast of India
13.	ERP/DOD/09	Farming and Pearl production in Black lip pearl Oyster *Pinctada margaritifera* in Andaman waters
14.	ERP/DOD/10	Studies on marine mammals of Indian Exclusive Economic Zone and the contiguous seas
15.	ERP/DOD/11	Predictive modeling of marine fisheries of the south west coast of India
16.	ERP/APC/21	Development of pro-active disease control strategies for sustainable shrimp farming using marine algal metabolites
17.	ERP/APC/22	National risk assessment programme for fish and fish products for Domestic and International markets
18.	ERP/APC/25	Economic evaluation of trawl fishing in Andhra Pradesh and Kerala
19.	ERP/APC/24	Cattle feed production from selective seaweeds of Indian Coast
20.	ERP/APC/19	Technological upgradation of edible oyster farming through development of remote setting and upwelling techniques

21.	ERP/APC/29	Seed production, farming and production of soft shelled crabs of Portunus pelagicus (Linnaeus)
22.	ERP/APC/26	Assessing the impact of fishing on the biodiversity pattern of commercial marine fishery resources of South west coast of India
23.	ERP/APC(Net)/38	Impact, adaptation and vulnerability of Indian Agriculture to climate change
24.	ERP/DOD/14	Tuna Resources of the Indian EEZ-An Assessment of growth and migratory patterns

Sponsored Projects (International)

SL. NO.	Project Code No.	Title of the Project
1.	ERP/IFS/03	Environment impact assessment of suspended culture of the green mussel *Perna viridis* and the edible oyster *Crassostrea madrasensis* in a tropical estuarine system

NATP Schemes

SL. NO.	Project Code No.	Title of the Project
PSR Mode Projects		
1.	2090000004	Breeding and culture of pearl oysters and production of pearls
2.	2090000008	Mussel Mariculture
3.	2090000015	Augumentation of marine fish production in Lakshadweep
CGP Mode Projects		
4.	2090000011	Designing and validation of communication strategies for sustainable/responsible fisheries - a co-learning approach
5.	2090000013	Broodstock development breeding, hatchery production and restocking of mud cabs
6.	2090000017	Development of a national referral laboratory for marine fish & shellfish microbial diseases
ATIC Project		
7.	2090000005	Establishment of National Agricultural Technology Information Centre
IVLP Project		
8.	2090000010	Technology assessment and refinement in coastal agro-ecosystems
MM Project		
9.	2090000017	National Integrated Resources Management System
Strengthening of Library		
10.	2090000006	Library Information System

Consultancies & Patents

Consultancies during the year 2004-2005

Sl.No	Name of Client	Project Title	Duration	Amount (Rs.)
1	M/s.Cochin Port trust	EIA of south W.Island	April, 2004-March, 2006	19,84,070/-
2	M/s.Prismack Ltd, Guntur	Discard data on east coast	June, 2004-July, 2004	12,312/-
3	M/s.KIOCL, Mangalore	Studies on siltation in the mining area of KIOCL	June, 2004-May, 2005	5,40,000/-
4	Surat Municipal Corporation, Surat,Gujarat.	Planning, construction management of Sweet, Brackish & Marine aquariums	Sept., 2004-Aug., 2006	19,17,000/-
5	M/s. Water &Power consultancy Services(India) Ltd, NewDelhi	Daily Discharge data of Bhadra river of Kannataka	Oct., 2004-Dec., 2004	1,60,892/-
6	Govt.Andhra Pradesh	Case study of Srikakulam district of Andhra Pradesh	Nov., 2004-Dec., 2004	51,004/-
7	M/s.Jadavpur University, Kalkata	Analysis of marine fish landings along the Digha costal zone of West Bengal	Jan., 2005-Feb., 2005	38,570/-
8	M/s.MRPL,Mangalore	EIA of Chithrapur Phase-9	Feb., 2005-Jan., 2006	7,71,000/-
9	M/s.NIO,Mumbai	Environmental base line studies ….. Orissa coast	Jan., 2005 Dec., 2005	1,10,000
	Total			**Rs. 55,84,848/-**

Patent applications filed during the year

S.No.	Name of Scientist/ Technical Officer	Name of Patent	Research Centre
1	Drs. S. Dharmaraj, Principal Scientist & C.P. Suja, Technical Officer	Pearl production techniques through tissue culture in the pearl oyster, *Pinctada fucata* and the abalone, *Haliotis varia* and other pearl producing molluscs (under global patent)	Tuticorin

Important Meetings

RAC

The 10th meeting of the Research Advisory Committee (RAC) of CMFRI was held at the CMFRI Headquarters on 25th and 26th February, 2005 under the Chairmanship of Dr. P.V. Dehadrai, former Deputy Director General, Fisheries, ICAR, New Delhi. The Chairman and Members of the RAC visited the Divisions, laboratories, the experimental hatchery and the Agriculture Technology Information Centre and interacted with the Heads of Divisions and the scientists before the commencement of the meeting. The meeting commenced with the welcome by Dr. Mohan Joseph Modayil, Director, CMFRI to the Chairman and members of the new Research Advisory Committee.

The following are the members of the reconstituted RAC of CMFRI

Dr. P.V. Dehadrai, Chairman
Dr. P. Kumar, Member RAC
Dr. P. Natarajan, Member RAC
Shri. K.V. Soman, Member RAC
Dr. A.D. Diwan, ADG (M.Fy.), ICAR & Member RAC
Prof. (Dr.) Mohan Joseph Modayil, Director, CMFRI & Member RAC
Dr. R. Paul Raj, Head, PNPD & Member Secretary, RAC
Dr. M. Srinath, Head, FRAD
Dr. E.V. Radhakrishnan, Head, CFD
Dr. N. G. K. Pillai, Head, PFD
Dr. K.K. Appukuttan, Head, Head, MFD
Dr. R. Sathiadhas, Head, SEETTD
Dr. (Mrs.) S. Sivakami, Head, DFD
Dr. (Mrs.) Rani Mary George, Head, MBD
Dr. G. Gopakumar, Head, MD

The Chairman, in his opening remarks commended the contributions made by this premier Institute to marine fisheries research and development in the country and complemented the leadership and the expertise available in the Institute. He emphasized that CMFRI should be the nodal institution in the country to create scientific information on marine living resources and to communicate the same to the policy makers and administrators to facilitate the process of policy formulation and decision making and called for strengthening the socio-economic component in research. The Chairman emphasized the need for innovative research to augment productivity, to address issues relating to poverty among fisherfolk and suggested that the projects targeting technology development should focus on cost-effectiveness and commercial viability.

The RAC after care for review of the current mandate of the Institute recommended revision of the mandate of the Institute keeping in view the programmes envisaged in the Vision 2020 document.

Some of the important recommendations of the RAC were as follows:

- Include the thrust areas, **Marine Biodiversity and Socio-economics** for improving the Vision 2020 document.
- Review the methodology and data collection system for capture fisheries –sampling-standard error in sampling, efficiency, trend should be analysed, risk analysis, management and sustainability to state the case for reconciliation of fish production data on national

basis.

- Integrate the farming of marine plants, mussels and oysters and sea-ranching.
- Prepare proposal along with cost-benefit analysis, IRR, on Bivalve (*Perna* sp and *Crassostrea* sp.) Mariculture to the Ministry of Agriculture and release the technologies ready for transfer and commercialization under possible national schemes. Hatcheries for *Crassostrea* sp. and *Perna* sp. have to be established for meeting seed requirements.

The RAC also recommended some major equipments for special sanction of the Council to implement the ongoing as well as the new projects highlighted in the Vision 2020 document.

IMC

The 60th IMC of CMFRI was successfully held on 09.11.2004. The meeting was chaired by Prof. (Dr.) Mohan Joseph Modayil and other members who attended were DDr.N.G.K. Pillai, Head, PFD, Dr.K.K. Appukuttan, Head, MFD, Dr.R. Paul Raj, Head, PNPD, Dr. R. Sathiadhas, Head, SEETTD, Shri. C.K. Soman, Non-official member and Shri. S. George, SFACO, CPCRI. Shri. K. L. Meena, SAO & Member Secretary presented the action taken report. Minutes of the 59th meeting of IMC held on 04.03.2004 was approved. As new items –(i) Proposal for construction of students hostel for girls, (ii) Nomination of new members to the Institute Grievance Committee and (iii) Proposal for procurement of equipments were approved. In addition, critical review of pending audit paras was made by the IMC.

QRT

The Director General, ICAR, constituted a QRT to review the work of CMFRI for the period 1999-2004 under the chairmanship of Dr. E.G. Silas, Former Vice Chancellor, Kerala Agricultural University. The other members of the QRT were Dr. Vinayshil Gautam, Prof. Amalesh Choudhary, Dr. S. L. Shanbhogue, Dr. G. Subramanian and Prof. N. R. Menon. Dr. E. V. Radhakrishnan, Member Secretary and Dr. E. Vivekanandan and Dr. K.S. Mohamed, Technical Coordinators assisted them.

The QRT with all the members met at CMFRI, Headquarters, Kochi during 21-23 August, 2004 and collected information on the organizational structure, infrastructure facilities, teaching programmes, research and extension activities. Subsequently the QRT visited Mandapam, Veraval and Visakhapatnam Regional centres and Calicut, Vizhinjam, Tuticorin, Mangalore, Karwar, Mumbai, Chennai, Kakinada and Minicoy research centres of CMFRI and conducted meetings with all the staff in each centre.

The committee, which undertook a detailed study of the progress of research in the institute, has finalized the report and recommendations, which is to be submitted to the DG, ICAR during 2005-06.

QRT at Cochin

Participation of scientists in conferences, meetings, workshops, symposia and training in India and abroad

Prof. (Dr.) Mohan Joseph Modayil, Director participated in the following meetings

National Coastal Zone Management Authority Meeting at Ministry of Environment and Forests, New Delhi (6 May).

Meeting with Social Scientists of ICAR for Development of Strategic Research projects at New Delhi (7 May).

Round Table Conference on 'Impact of Inter River Basin Linkages on Fisheries' at NAAS, New Delhi (21 May).

Meeting alongwith FSI, DBT and Department of Fisheries, Govt. of Maharashtra to chalk out the detailed programme on Aquaculture of Shellfishes on the coast of Ratnagiri in collaboration with Dr. Babasaheb Ambedkar Marathwada University at their Marine Research Laboratory, Ratnagiri (22 & 23 May).

NATP National Symposium on 'Enhancing Productivity and Sustainability in Coastal Agro Ecosystem' organized by AED (Coastal) at CTCRI, Thiruvananthapuram (9-10 June).

National Workshop on Coastal Zone Management at Chennai (18-19 June).

ICAR Institute's Directors' Conference at NASC Complex, New Delhi (14-16 July).

Seminar on Sustainable Fisheries Development – Focus on Andhra Pradesh organized by Society of Fisheries Technologists and CIFT at Visakhaptnam (23 July).

National Coastal Regulation Zone Meeting under the chairmanship of Prof. (Dr.) M.S. Swaminathan, Swaminathan Research Foundation, Chennai (30 July).

ICAR Fisheries Director's Meeting and discussion on Perspective Plan Document at ICAR, KAB, New Delhi (10 August).

Planning meeting of MRAG-DFID Fisheries Management Science Programme at Fisheries College, Mangalore (18 -19 September).

First Inter-face meeting on Aquaculture held at CIFA, Bhubaneshwar (27 and 28 Sept).

Meeting on SDR for Lakshadweep sponsored by the Planning Commission organized by the Institute of Applied Manpower Research in collaboration with the Administrator, Union Territory of Lakshadweep held at Kavaratti (12-13 October).

Discussions and deliberations on Vision 2020 Perspective Plan Document for fisheries sector alongwith the DDG (Fy.), ICAR, SMD and other experts held at NASC Complex, New Delhi (26-28 October).

International Workshop on 'Policy Research for Sustainable Shrimp Farming in Asia' organized by University of Agricultural Sciences and held at Bangalore (9-10 December).

Brain storming session on Disaster Management at CIFT Cochin under the Chairmanship of DDG (Fisheries) on 21st January 2005.

Participated in the Seminar on 'Untapped potential of seaweed resources of Tamil Nadu and the scope for gainful employment of self help women groups of the coastal poor in seaweed farming' organized by the Aquaculture Foundation of India in collaboration with CMFRI, Kochi and CSMCRI, Bhavanagar, Gujarat at CMFRI, Mandapam Camp, Tamil Nadu (21-23, February).

International Symposium 'Sustain Fish 2005' organized by School of Industrial Fisheries, CUSAT, Kochi and University Grants Commission, New Delhi (23 - 25 March).

Scientists of the institute participated in the following conferences, meetings, workshops, symposia and training

Winter School on 'Towards ecosystem based management of marine fisheries – building mass balance trophic and simulation models at Kochi, 30 September-20 October 2004.(as Faculty Members) –***Drs. N.G.K. Pillai, K.K. Appukuttan, G. Nandakumar, C.P. Gopinathan, S. Sivakami, E. Vivekanandan, P.K. Krishnakumar, P.U. Zacharia and T.V. Sathianandan.***

International Conference on Agricultural Heritage of Asia at NAARM, Hyderabad organized by Asian Agri-History Foundation, Hyderabad and presented a paper entitled "Heritage of fisheries in India" , 6-8 December 2004 ***–Dr. N.G.K. Pillai.***

Winter School on 'Recent advances in mussel and edible oyster farming and marine pearl production' at CMFRI, Cochin (as Faculty Member) from 11-31 January 2005 - ***Dr. N.G.K. Pillai.***

International Symposium 'Sustain Fish 2005' organized by School of Industrial Fisheries, CUSAT and University Grants Commission at Kochi, 23-25 March, 2005 - ***Drs. N.G.K. Pillai, R. Sathiadhas, G. Gopakumar, P.K. Krishnakumar, K.S. Mohamed, P.U. Zacharia, E. Vivekanandan and Joe K. Kizhakudan.***

One day Consultation on Natural Resources of Kerala organized by Kerala Agricultural University, College of Horticulture, Vellanikkara, Trissur, 7 September 2004 - ***Dr. A.A. Jayaprakash.***

27th Tamil Nadu State Fisheries Research Council Meeting at Department of Veterinary & Animal Sciences, Chennai, 12 July 2004 - ***Dr. H. Mohamad Kasim.***

Second meeting of Task Force Committee on Fisheries Development Mission at the Chambers of the Secretary to Government, Animal Husbandry and Fisheries Department, Chennai, 2 August 2004 - ***Dr. H. Mohamad Kasim.***

XV Meeting of consultative group for Chennai base of Fishery Survey of India at FSI, Chennai, 9 September 2004 - ***Dr. H. Mohamad Kasim.***

Symposium on 'Managing Marine Reserves – Challenges and the Way Forward' at Greenpeace, Chennai, 7 November 2004 - ***Dr. H. Mohamad Kasim.***

Task Force Committee Meeting at the Animal Husbandry & Fisheries Department, Secretariat, Chennai, 5 January 2005 - ***Dr. H. Mohamad Kasim.***

Discussion on Tsunami Relief and Rehabilitation – Perspectives and Challenges in the context of the Aquarium (Fishing) Economy of Tamil Nadu at the Madras Institute of Development Studies, Chennai, 7 January 2005 - ***Dr. H. Mohamad Kasim.***

Meeting of M.S. Swaminathan Research Foundation to discuss on Tsunami Relief and Rehabilitation strategy to build up livelihood enhancement opportunities to the affected families, 10 January 2005 - ***Dr. H. Mohamad Kasim.***

Consultative meeting for development of fisheries and related activities to enhance the income generation for poor fishermen in coastal areas of Tamil Nadu for both sea and inland fishing at Directorate of Rural Development, Chennai, 18-21 February 2005 - ***Dr. H. Mohamad Kasim***

Workshop on Post Tsunami Rehabilitation and Future Prospects in Fisheries Sector in Nagapattinam at Fisheries Department, Nagapattinam, 13 March 2005 - ***Dr. H. Mohamad Kasim.***

Seminar on 'Problems and prospects of ornamental fish culture' organized by National Agriculture Society held at Regional Science Centre, Kozhikode, 3 October 2004 - ***Dr. P.N. Radhakrishnan Nair.***

Consultative Committee Meeting for the 'Farm and Home Programme' of All India Radio, Kozhikode held at Milma, Kunnamangalam, 7 October 2004 - ***Dr. P.N. Radhakrishnan Nair.***

Sensitization programme on business opportunities in Biotechnology at Calicut organized jointly by Small Industries Service Institute, Thrissur, IISR, Kozhikode and District Industries Centre, Kozhikode, 19 January, 2005 - ***Dr. P.N. Radhakrishnan Nair.***

Seminar on 'CRZ Rules and coastal protection' organized by MICTRA at Calicut, 22 January 2005 - ***Dr. P.N. Radhakrishnan Nair and Shri. K.K. Philippose.***

Training on networking and ERNT connectivity at NAARM, Hyderabad, 9-13 August 2004 - ***Dr. A.K.V. Nasser.***

National Symposium cum Exhibition in enhancing productivity and sustainability in coastal agro ecosystem at CTCRI, Trivandrum, 9-11 June 2004 - ***Shri K.P. Said Koya.***

Sensitization Training Workshop on implementation of PIMSNET at CTCRI, Trivandrum, 8-9 July 2004 - ***Shri K.P. Said Koya, Drs. K.K. Appukuttan and T.S. Velayudhan.***

Farmer's Training Programme 2004-05 conducted by the Department of Animal Husbandry & Agriculture at Agricultural Office, Minicoy, 11-15 February 2005 - ***Shri K.P. Said Koya.***

Seminar & Workshop organized by the Department of Science & Technology in connection with the 'Year of Scientific awareness' at Minicoy, 18-19 March 2005 - ***Shri K.P. Said Koya.***

Attended the 'Ornamental Fish Seminar held at International Hotel, Kochi jointly organised by Govt. of India and Government of Kerala, 20 November 2004 - ***Dr.S.Sivakami.***

Attended the meeting on Deep Sea Fishing Policy meeting held at CMFRI, Kochi, 19 November 2004 - ***Dr.S.Sivakami.***

Participated in the Seminar on Fishing harbours organised by Protsahan at Cochin, 24 -25 June 2004 - ***Dr. E. Vivekanandan.***

Participated and presented a paper in the Colloquium on Artisanal Fishing Methods organised by India International Centre at New Delhi, 8 October 2004 - ***Drs. E. Vivekanandan and M. Rajagopalan.***

Attended the Indo Singapore Joint Workshop at Avenue Regent, Ernakulam organised by DBT & Cochin University of Science Technology, Kochi, 22 – 24th April 2004 - ***Drs. L. Krishnan, E.V. Radhakrishnan, G. Maheswaradu, M. Rajagopalan, P.C. Thomas and P. Jayasankar.***

Participated in the National Seminar in Hindi on "Diversification of fishery products" "organised by Veraval Research Centre of CIFT 7 December 2004 - ***Dr. K. V. Somasekharan Nair.***

Participated in the two day workshop on Fisheries Management at Veraval organised by Protsahan, 8 - 9 December, 2004 - ***Dr. K. V. Somasekharan Nair.***

Participated in the Workshop-cum-Training on Planning, Monitoring and Evaluation organized by the NCAP, New Delhi, 17 -18 March 2005 – ***Dr. E. V. Radhakrishnan.***

Addressed the participants in the captioned mariculture programmes conducted by State Bank Institute of Rural Development, Kochi, 3 November 2004 - ***Drs. E. V. Radhakrishnan and K.S. Mohamed.***

Attended meeting at MPEDA, Cochin to review the progress of work in the project "Participatory management and conservation of lobster resources along the southwest coast of India" on 22 December 2004 – ***Dr. E. V. Radhakrishnan***.

Seminar on "Sustainable fisheries development focus on Andhra Pradesh organized by the Society of Fisheries Technologists (India) Kochi and CIFT, Visakhapatnam 23 July 2004 – ***Drs. G. Maheswarudu***, ***G. Syda Rao.***

Workshop on "Correct use and upkeep of Fish Finders, GPS, Echo sounders and Radio telephone" conducted by CIFNET, Visakhapatnam, 23 November 2004 - ***Dr. G. Maheswarudu***.

Seminar on prospects of ornamental fish culture and Aquatic Plants organized by National Aquariculture Society, Kozhikode and Malabar Botanical garden, Kozhikode at Regional science Centre, Kozhikode, 21 September 2004 - ***Shri K.K. Philippose.***

Attended the training Programme on Ornamental fish Culture organized by BFFDA Calicut at Fisheries complex West Hill, Calicut as a resource person and took class on "Marine ornamental fish resources of India", 13 September 2004 - ***Shri K.K. Philipose.***

As a resource person for the refresher course in environmental science conducted by the UGC-ASC, University of Calicut. Took classes on Ornamental fish resources and Culture at the Botany Department, University of Calicut, 16 January 2005 - ***Shri K.K. Philipose.***

Attended the Technical Advisory Committee meeting of District planning board at District Collectorate, Kozhikode, 4 August 2004 and 20 December 2004 - ***Shri K.K. Philipose.***

Attended Winter School on "Towards ecosystem based management of marine fisheries, building mass balance trophic and simulation models conducted by CMFRI, Kochi, 30 September 2004 – 20 October 2004 – ***Smt. P.T.Sarada, Smt. S.Lakshmi Pillai, Smt. Rekha Devi Chakraborty, Shri. A.P. Dineshbabu.***

Participated in a farmer's meet organized by BFFDA at fishermen's training centre, Kannur and gave a talk on "Problems and Prospects of crab culture", 13 September 2004 – ***Smt. P.T.Sarada.***

Participated in the National Official Language Seminar on 'Issues in Aquatic Biodiversity' held at CMFRI, Cochin, 1 February 2005 - ***Drs.G.Nandakumar, Mary K. Manisseri, Rani Mary George, P. Kaladharan, Smt. Rekha Devi Chakraborty and Smt. T.S. Naomi.***

Attended a seminar on "Larval Recruitment and phytoplankton dynamics" at CIFT, Cochin, 29 December 2004 – ***Smt. Rekha Devi Chakraborty.***

Attended the Symposium on NATP Projects at CTCRI, Sreekaryam and presented the Results on NATP project on Pearl Mariculture, 9-10 June, 2004 - ***Dr. K.K. Appukuttan.***

As Director of Winter School, conducted the Winter School on 'Recent advances in mussel and edible oyster farming and marine pearl production', 11-31 January 2005 - ***Dr. K.K. Appukuttan.***

Participated in the Symposium organized by ISAS, New Delhi held at CMFRI, Cochin, 20-22 January 2005 - ***Drs. K.K. Appukuttan, E.V. Radhakrishnan, N.G.K. Pillai, M. Srinath, R. Sathiadhas and S. Sivakami.***

Attended 'Tsunami' meeting conducted by the Indian Meteorological Department, Visakhapatnam, 31 December 2004 - ***Dr.G. Syda Rao.***

Attended Seminar on 'Impact on quality of life by Department of Atomic Energy' as a part of their Golden Jubilee celebrations held at HWP, Tuticorin, 2 July 2004 - ***Dr. A.C.C. Victor.***

Attended Training course on 'Decision Makers' at IIRS, Dehradun, Uttaranchal, 21-24 September 2004 - ***Dr.A.C.C. Victor.***

Attended Interface meeting of DAC-DAH &D-DARE on Aquaulture at the Central Institute of Freshwater Aquaculture, Bhuvaneswar, 27-28 September 2004 - ***Drs. S. Dharmaraj, V. Kripa and Joe K Kizhakudan.***

National Symposium on Recent trends in fisheries education and research at FCRI, Tuticorin, 4 December 2004 - ***Smt. P.S.Asha.***

National Seminar on Ecological Balance and Sethusamudram Canal at Alagappa University, Karaikudi, 1-3 October 2004 - ***Smt. Bindu Sulochanan.***

Workshop on Integrated Management strategies for Tamilnadu coastal zone and its resources organized by the Institute of Remote Sensing and Institute for Ocean Management, Anna University, Chennai, 26 November 2004 - ***Smt. Bindu Sulochanan.***

Workshop on Forestry for disaster management of Kerala organized by Dept of Forests, Govt. of Kerala, Trivandrum, 2 March 2005 – ***Dr. J.P. George.***

Workshop on Foreign Strategic Linkages between Local Govts. and R& D Institutions, sponsored by Kerala State Planning Board and Centre for Environment & Development at Trivandrum, 3 March 2005- ***Dr. J.P. George.***

Coordinator and Faculty to Training programme on Phytoplankton identification/Taxonomy at CMFRI, Cochin, 14 -19 June 2004 -***Dr. C.P.Gopinathan.***

National Symposium on Algal Biology & Industrial Application at the Krishnamurthy Institute of Algology, Chennai, 23-24 September 2004 – ***Dr. N. Kaliaperumal.***

National Seminar on Present scenario in Plant Science Research at Department of Botany, Annamalai University, Annamalai Nagar, 19-20 February 2005 - ***Dr. N. Kaliaperumal.***

National Seminar on Untapped potential seaweed resources of Tamilnadu and scope for gainful employment of self help women groups of coastal poor in seaweed farming at Regional Centre of CMFRI, Mandapam Camp, 21-23 February 2005 - ***Drs. N. Kaliaperumal***, ***M. Rajagopalan, M. Rajamani and Smt. Bindu Sulochanan.***

Training on Multivariate statistical methods in Fisheries Research at CMFRI, Cochin, 18 March -7 April 2004 - ***Dr. P. Kaladharan and Shri K. Vijayakumaran.***

National Training on Prioritization Techniques in Fisheries Research at NAARM, Hyderabad, 5-11 August 2004 - ***Dr. P. Kaladharan.***

Coordinator and Faculty to Training Programme on Post harvest and value addition techniques in seaweeds at the Mandapam Regional Centre of CMFRI, 20-25 September 2004 - ***Dr. P. Kaladharan.***

Workshop on Impact Assessment and Vulnerability of Marine Fisheries to Climate Change at CMFRI., Cochin, 29-30 November 2004 - ***Drs. P. Kaladharan, and P.K. Krishnakumar.***

National Hindi Seminar on Advances in aquatic biodiversity Conservation and Management at CMFRI.., Cochin, 1 February 2005 - ***Dr. P. Kaladharan.***

Fourth National Seminar on Wetland Resources of India organized by the Limnological Association of Kerala and Sacred Heart College, Chalakudy, 2-4 February 2005 -***Drs. P. Kaladharan and J. P. George.***

Round Table on Impact of inter river basin linkage on Fisheries organized by National Academy of Agricultural Sciences, New Delhi, 21-22 May 2004 - ***Dr. P. K. Krishnakumar.***

Second review workshop of the DOD-MLRE project on Studies on marine mammals of Indian EEZ at CMFRI, Cochin, 9-11 August 2004 - ***Drs. P. K. Krishnakumar, E. Vivekanandan, P. Kaladharan, P. Jayasankar, P. Jayasankar and Shri. K.P. Said Koya.***

Third review workshop of the DOD-MLRE project on Studies on marine mammals of Indian EEZ at CMFRI, Cochin, 1-2 December 2004 - ***Dr. P. K. Krishnakumar and Shri. K.P. Said Koya.***

Project launching meeting of the ICAR Network project on Impacts, Adaptation and Vulnerability of the Indian Marine Fisheries to Climate Change at CRIDA., Hyderabad, 20-21December 2004 - ***Drs. M. Rajagopalan and P. K. Krishnakumar.***

Research Associate's meeting of the ICAR Network project on Impacts, Adaptation and Vulnerability of the Indian Marine Fisheries to Climate Change at CMFRI, Cochin 1March 2005- ***Drs. P. K. Krishnakumar and P. Kaladharan.***

Project formulation workshop on Organic Aquaculture, at ICAR, New Delhi, 3 - 4 May 2004 - ***Drs. D. Prema, K. R. Manmadhan Nair, V. Kripa and Joe K. Kizhakudan.***

Annual Review Workshop on the network project National Risk Assessment Programme for fish and fish products for domestic and International marketsat ICAR, New Delhi, 21 July 2004 - ***Dr. D. Prema.***

Indo-Singapore Workshop on Frontiers in Aquaculture and Marine Biotechnology organized by DBT, New Delhi on 23rd April 2004 at Cochin- ***Dr. M. Rajagopalan***

Meeting with Director, Dept of Fisheries, Govt of Orissa on sea turtle conservation issues at Bhubaneswar, 6-7 May 2004 - ***Dr. M. Rajagopalan.***

National workshop on fish for all through quality fisheries education**,** Kerala Agricultural University at Cochin, 25 November 2004 - ***Dr. M. Rajagopalan.***

Meeting organized by Department of Science and Technology and Environment, Government of Kerala on 'Disaster mitigation measures and to evolve an action plan for Tsunami disaster at Cochin, 15 January 2005 - ***Dr. M. Rajagopalan.***

Brain storming session on Disaster Management at CIFT Cochin under the Chairmanship of DDG (Fisheries), 21 January 2005- ***Drs. M. Rajagopalan, P.Kaladharan, R. Sathiadas, E.V. Radhakrishnan, S.Sivakami, N.G.K. Pillai, R. Paul Raj and P. Sayasankar.***

Meeting on Seacucumber Project at Agatti, Lakshadweep at Lakshadweep Development Corporation, Cochin, 27 January 2005 - ***Dr. M. Rajagopalan.***

Meeting with the Director, CARI in connection with Impact study of Tsunami in Andaman & Nicobar Islands at Port Blair, 4 -11 February 2005 - ***Drs. M. Rajagopalan and Rani Mary George.***

Training on Introduction to GIS and its application at N. R. S. A., Hyderabad, 14 February - 11 March 2005 - ***Dr V. V. Singh.***

Training on Remote Sensing: An overview for decision makers at IIRS., Dehradun, 21– 29 September 2004 - ***Dr V. V. Singh.***

Working group meeting for the development of competency based modular curriculum in marine fisheries at NCERT, Bhopal, 2 - 6 November 2004 - ***Dr V. V. Singh.***

Course writer's workshop for laboratory course in coastal aquaculture at IGNOU, New Delhi, 12 -14 August 2004 - ***Dr V. V. Singh.***

Faculty to winter school on remote sensing and GIS applications in fisheries at CIFE., Mumbai, 15 January 2005 - ***Dr V. V. Singh.***

Country planning workshop on DFID funded project on Enabling better management of fisheries conflicts at Visakhapatnam, 1-2 June 2004 - ***Shri. K. Vijayakumaran.***

International workshop on Enabling better management of fisheries conflicts organized by the Mitranikethan, Trivandrum and World Fish Centre, Trivandrum, 6- 7 July 2004 - ***Shri. K. Vijayakumaran.***

Workshop on How to develop a winning proposal at NAARM, Hyderabad, 17-21 August 2004 - ***Shri. K. Vijayakumaran.***

Dr. V.S. Krishna Birth Centenary Seminar on New trade policy and WTO regime at Andhra University, Visakhapatnam, 8 October 2004 - ***Shri. K. Vijayakumaran.***

Network meeting convened by DDG, Fisheries, ICAR at New Delhi for discussion and formulation of project proposals in Network mode on the subject 'Fish Feeds and Feed Technology', 27-28 April 2004 - ***Drs. R. Paul Raj, P. Vijayagopal and Imelda Joseph.***

Participated in the National Symposium cum Exhibition or Enhancing Productivity and Sustainability in Coastal Agro-Ecosystem organized by NATP at CTCRI, Trivandrum, 8-11 June 2004 - ***Dr. R. Paul Raj.***

Participated and gave a lecture on "Recent advances in Aquatic Nutrition" in the Vth Biennial Conference of Animal Nutrition Association at National Institute of Animal Nutrition and Physiology, Bangalore, 24 -26 November 2004 - ***Dr. R. Paul Raj.***

Attended the Meeting to establish Standards for fish and fishery products, including fish seed and feed organized by Bureau of Standards, Government of India, held at CIFT, Kochi, 20 January 2005 - ***Dr. R. Paul Raj.***

Participated and presented a concept note in the Network Meeting on 'Auto Transgenics' at, ICAR, New Delhi, 14 -15 April 2004 - ***Drs. P.C. Thomas and P. Jayasankar.***

International Conference on Bio-technology and Neuroscience at CUSAT 29-31 December, 2004 - ***Dr. P.C. Thomas***

Network Meeting on Fish health and Disease Management at KAB-II on 28-30 April 2004 - ***Drs. A. P. Lipton, K.C. George and K.S. Sobhana.***

Meeting on "Microbes in agriculture" convened by DDG (Fy), ICAR at Krishi Anusandhan Bhavan- II, Pusa, New Delhi, 9 August 2004 - ***Drs. A. P. Lipton and Imelda Joseph.***

Participated and took class on "Shrimp diseases and control measures" for the farmers' training programme, organized by the Agency for development of Aquaculture, Kerala (ADAK) at Moolampally, 3 November 2004 - ***Drs. K.C. George and K. S. Sobhana.***

Meeting of the Institute Management Committee of NBFGR, Lucknow, 18 September 2004 - ***Dr. P. Jayasankar.***

Brainstorming session on Aqua Genomics organized by DBT at New Delhi, 19 November 2004 - ***Dr. P. Jayasankar***.

Meeting of the Institute Management Committee of NBFGR, Lucknow, 11 March 2005 - ***Dr. P. Jayasankar.***

Training on Networking and ERNET Connectivity at NAARM, Hyderabad, 20-24 September 2004 - ***Dr. P. Vijayagopal.***

Participated and taken class on "Post stocking shrimp health management" for the farmers' training programme on "Sustainable shrimp aquaculture development in Pokkali fields", organized by the Agency for development of Aquaculture, Kerala (ADAK) at Chellanam, 6 November 2004 and North Parur, 8 October 2004 - ***Dr. K. S. Sobhana.***

Participated in "Disease management in aquaculture" for the farmers' training programme on Environment friendly Aquaculture practices, organized by the College of Fisheries, Panangad, 26 October 2004 - ***Dr. K. S. Sobhana.***

Attended the National workshop on "Fish for all through quality Fisheries Education" organized by the College of Fisheries, Panangad, 25-27 November 2004 - ***Dr. K. S. Sobhana.***

Symposium on NATP Projects / IVLP at CTCRI, Sreekaryam, 8 -10 June 2004 - ***Dr. R. Sathiadhas.***

National Workshop on Fishery Harbours organised by PROTSAHAN, Trivandrum, 24 - 25 June 2004 - ***Dr. R. Sathiadhas.***

Sensitization Training Workshop (PIMSNET) under coastal Agro-ecosystem Directorate organised by CTCRI, Trivandrum, 7- 9 July 2004 - ***Dr. R. Sathiadhas.***

Institution Management Committee Meeting at CMFRI, 9 November 2004 - ***Dr. R. Sathiadhas.***

Seminar on Ornamental Fish Culture at Inter National Hotel, Ernakulam, 20 November 2004 - ***Dr. R. Sathiadhas.***

National Advisory Committee of SUSTAINFISH-2005 at Woods Manor Hotel, Cochin 22 December 2004 - ***Dr. R. Sathiadhas.***

Statistical Conference at CMFRI, Cochin 20 – 22 January 2005 - ***Dr. R. Sathiadhas and V.P. Vipinkumar.***

Regional workshop on "Engendering agricultural research and extension" held at Center for Studies on gender Issues in agriculture, KAU, Thrissur, 10-15 January 2005 – ***Dr. C. Ramachandran.***

ATIC National Review Meeting held at Kerala Agricultural University Thrissur, and presented the progress report of CMFRI, ATIC, 6 -7 August 2004 - ***Dr. V.P. Vipinkumar.***

National Seminar on Development Initiative among Farming Community, Extension Strategies, Indian Society of Extension Education, IARI, New Delhi held at University of Agricultural Science, Bangalore, 21- 23 January 2005 - ***Dr. V.P. Vipinkumar.***

Workshops Seminars Summer Institutes Farmer's Day Organised

Winter school on "Ecosystem based management of marine fisheries-towards building mass balance and simulation models during 30th September to 20th October 2004. Twenty five participants from ICAR Institutes and Agricultural Universities participated.

Winter School on **"**Recent advances in mussel and edible oyster farming and marine pearl production" from 11th January to 31st January, 2005. Seventeen participants from different Universities and ICAR Institutes participated.

Pearl workshop under the project "Breeding and culture of pearl oysters and production of pearls" organized during 29th & 30th November 2004.

Organized mussel farmers meet at Padanna on November 29th 2004. Two hundred and thirty three women farmers attended the meet.

A training programme on "Phytoplankton identification/Taxonomy conducted by the FEM Division at CMFRI, Cochin during 14th-19th June 2004. Six Scientists from various ICAR Institutes participated.

A training programme on the "Post harvest and value addition techniques in seaweeds" was conducted by the FEM Division at the Mandapam Regional Centre of CMFRI during 20th-25th September 2004. Eleven trainees, eight of them women including an IFS Officer, seaweed industry personnel, sea farmers, research scholars and extension workers participated in the training.

A brainstorming session was held at CMFRI, Cochin on 04.08.2004 for FEMD project "GIS Based Atlas on potential mariculture sites along Indian coasts" to highlight its importance and also to exchange the ideas for proper implementation in initial stages.

A training programme on "Seaweed cultivation and post-harvest technology" to 2 trainees conducted at the CMFRI Regional Centre, Mandapam during 14th - 19th March 2005.

Training programme on Instrumentation Techniques in Biotechnology organized for faculty and students of Rai University, Cochin campus.

A brainstorming session on Application of genetics in ratification of species status and stock delineation" was organized at Cochin on 14 March, 2005 to discuss various issues related to the use of genetic markers in fish and shellfish species ratification, stock delineation and management.

A Training Workshop on Marine Pearl Culture was organized at Minicoy Research Center from 30th Sept to 4th October under the NATP on Augmentation of Marine Fish Production in Lakshadweep. The training Workshop, the first of its kind in Lakshadweep, was attended by a total of 48 participants including prospective entrepreneurs, resource personnel, educated youths, presidents of various NGOs and 12 students with the biology teachers belonging to various Science clubs.

Training workshop on Fish Aggregating Devices was organized at Minicoy Research Center under the NATP on Augmentation of Marine Fish Production in Lakshadweep from 25th to 26th November. The Training Workshop, the first of its kind in CMFRI was attended by a total of 72 fishermen, Kelus, Village Moopans, elected members and 11 heads of the various departments who are directly or indirectly associated with

the fisheries development.

Initiated a centrally sponsored massive project on **Marine Fisheries Census 2005** during the year. This project is a component of the scheme on "Strengthening of Database and Information Network for the Fisheries Sector" of the Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture.

Conducted a training programme on **Multivariate Statistical Methods for Fisheries Research** to scientists, university teachers and other research workers in fisheries, from 18th March to 7th April, 2004 at CMFRI, Cochin.

National Hindi Seminar on Issues in Aquatic Biodiversity

Conducted a training programme on **Marine Fisheries Data Collection and Estimation** for the staff of Dept. of Fisheries, Kerala from 7th-11th June, 2004.

Conducted 6 training programmes on **'Marine Fisheries Census'** at Mandapam, Chennai, Visakhapatnam, Mangalore, Mumbai and Cochin for the Zonal/Field/District level supervisors during Jan – Feb, 2005.

Organized the **58th Annual Conference of Indian Society of Agricultural Statistics** (ISAS) during 20th-22th January, 2005 at CMFRI, Cochin.

Distinguished Visitors

Cochin

Dr. John Warford and Dr. Konda P. Reddy from Tropical Marine Science Institute, Singapore.

Dr. P. Natarajan, Professor, Kerala University.

Dr. K. Ramalingam, Professor,, Govt. Arts College, Chennai.

Dr. M.J. Chandragowda, Sr. Scientist, ICAR TOT Projects, Z.C. Unit, Bangalore.

Dr. M.V. Kulsy, FAO Consultant

Dr. J.P. Mittal, National Co-ordinator (ITD), ICAR, New Delhi.

Mr. Sanjay Nandan, IAS, Commissioner of Fisheries, Gujarat.

Dr. S. C. Mukherjee, Director, CIFE, Mumbai.

Dr. S.L.Mehta, ITD, PIU-NATP, KAB, Pusa, New Delhi.

Dr. R. Parshad, ADG (Agri. Extension), ICAR, New Delhi.

Dr. Yugraj Singh Yadava, Member Secretary, Aquaculture Authority, Ministry of Agriculture, Govt. of India.

Mr. Lutz Asbeck, Chairman & Mr. Volker Kuntzsh, Director (Supply Management), Frozen Fish International, Bremerhaven, Germany.

Shri Shivram Warrior, Vice President & Shri Salim David, Business Manager, Marine Exports Hindustan Lever Limited, Bangalore.

Shri M.K.R. Nair, Development Commissioner (Fisheries), AH&D, Ministry of Agriculture, New Delhi.

Shri P.M.A. Hakeem, Secretary, AH&D, Ministry of Agriculture, New Delhi.

Shri Direndra Kashyap, IPS, Commissioner of Police, Kochi City.

Dr. N. Balaraman, Vice Chancellor, TANUVAS, Chennai.

Dr. K.H. AliKunhi, Former Director CIFE and FAO expert (24 February)

Dr. A.R. Kidwai, Governor of Haryana

Board of Regents of the University of Agricultural Sciences, Bangalore:

Dr. H.L. Harish, Dr. B.N. Krishnaiah, Shri. H.R. Chandregowda,

Dr. T.K. Prabhakara Shetty and Dr. H.R.V. Reddy

Veraval

Dr. H.V. Joshi and Shri Shaik Basha, Scientists, CSMCRI, Bhavnagar.

Mrs. Nalini Nayak and A.J. Vijayan, Protsahan, Trivandrum.

Shri Naresh Dali, Boat Owners Association President, Veraval.

Krishi Vigyan Kendra, Narakkal

Dr E.G. Silas, former Director, CMFRI and former Vice-Chancellor, Kerala Agricultural University, Mannuthy, Trichur.

Dr S. Ayyappan, Deputy Director General (Fy), Indian Council of Agricultural Research, New Delhi.

Dr V. Balakrishnan, former Training Organiser, Krishi Vigyan Kendra, Narakkal.

Visit of Commissioner of Police, Cochin, Mr. Dhinendra Kashyap, IPS

Visit of Shri P.M. Hakkim. IAS, Secretary, Animal Husbandry & Fisheries, ICAR

Smt M. Sreedevi, Assistant Director of Agriculture, Krishi Bhavan, Narakkal.

Shri N. Krishnaswamy, Assistant Director, Central Integrated Pest Management Centre, Ministry of Agriculture, Government of India, Ernakulam.

Dr H.V. Singh, Scientist, Centre for Earth Sciences, Thiruvananthapuram.

Vizhinjam

Shri. Kanti Desai, Honorable Minister for Education, West Bengal

Dr. I.V. Subba Rao, Member, ICAR High Power Committee and Former Vice Chancellor, Acharya NG Renga Agricultural University, Hyderabad.

Dr. A.K. Jain, Assistant Director General (ARIS), ICAR, New Delhi.

Major General K.M. Bhat, Addl. Director General (Army Edn.), New Delhi.

Minicoy

Dr. P.P. Koya, Hon'ble Member of Parliament.

Shri. L.G. Ibrahim Manikfan, Chairperson, Minicoy Dweep Panchayath.

Dr. V.S. Somvanshi, Director General, FSI, Mumbai.

Dr. E.G. Silas, Chairman, QRT and Dr. Amalesh Chowdhury, Member QRT.

Dr. V. Rajagopal, Director, CPCRI, Kasaragod.

Dr.M.E.John, Zonal Director, Fishery Survey of India, Mormugao Zonal Base, Goa, and Mr.A.Androse, Senior Scientist, FSI, Kochi.

Shri. Ranjeeth Singh, Shri.Dhananjay Singh, Shri.Manoj K Dwivedi, Shri.Ashok Kumar Meena, Shri,Amith Kumar and Ms.Richa the DANIL Probationary Officers

Shri. A. K. Sankaranarayanan, Field Publicity Officer, Kavaratti and Dr.P.P.Jaleel, Field Publicity Assistant, Kavaratti.

Shri. Manoj K. Dwivedi, Deputy Collector, Minicoy.

Dr. S. Suresh Kumar, MES Ponnani college, Ponnani, Kerala and 12 Postgraduate students

Tuticorin

Dr. S. Ayyappan, DDG (Fy.), ICAR, New Delhi.

Dr. Edison, Director, AED, CTCRI, Trivandrum.

S/Shri Kishore Dehi/Nevielle Tata Reji Koppara, Trident Aqua, Mumbai.

Shri. S.L. Prasad, Senior Commandant, CISF, Chennai.

Shri Dhanushkodi Athithan, Member of Parliament from Tirunelveli

Chennai

Dr. Mangala Rai, Director General, ICAR, New Delhi.

Dr. S. Ayyappan, Deputy Director General (Fy.), ICAR, New Delhi.

Smt. Sashi Misra, Secretary, DARE, ICAR, New Delhi.

Dr. R.J. Asari, Conservator of Forests, Marine National Park, Jamnagar.

Shri. Viswanath A. Shegaonkar, Secretary to Department of Animal Husbandry & Fisheries, Govt. of Tamil Nadu and Dr. M. Sakthivel, Chairman, AFI.

Shri B.L. Jangira, Director Finance, ICAR, New Delhi.

Quinquennial Review Team with Dr. E.G. Silas, Former VC and Former Director as Chairman, Dr. Amalesh Choudhary & Dr. G. Subramanian as Members visited the Research Centre to review the progress of research works, institutional activities and other developments.

Shri V.P. Kothiyal, Director Works, ICAR.

Kakinada

Smt.Hemavathy and Smt.I.V.Laxmi, Lecturers, Zoology Department, A.S.D.Collge for Women, Jagannaickpur, Kakinada along with 15 students of the B.Sc.(Zoology), 23rd September 2004.

Dr.C.T.Achuthankutty and Dr.Z.A.Ansari, Scientist-F, National Institute of Oceanography, Dona Paula, Goa 25, February 2005.

Visakhapatnam

Shri. G.V.S. Prasad, CEO, Golden Aquafarms, Thimmepuram.

Shri. P. Narayana Rao and Shri. K. Prasad, Aquafarm, Katrameri .

Dr. N. Nageswara Rao, District Collector, Srikakulam, Andhra Pradesh.

Dr. S. Ayyappan, Deputy Director General (Fy.)

Dr. Rama K. Raju, Senior Manager – QHSE, Reliance Industries Limited, Mumbai.

Karwar

Prof. Ravichandra Reddy, Prof. Jayaprakash and Dr. Bela Zutshi, alongwith 56 post graduate students, Department of Zoology, Bangalore University.

Mangalore

Dr.S.A.H.Abidi, Member, (AS) Agricultural Scientists Recruitment Board, New Delhi.

Dr.S.C.Mukherjee, Director, CIFE, Mumbai.

Dr. E.G.Silas, Chairman, Quinquennial Review Team, Dr. Amalesh Chaudhury &

Dr. S.L. Shanbhogue, Members, Quinquennial Review Team.

Dr.Nitisha Patankar, Project Team Member, NEERI, Nehrumarg, Nagpur.

Mr.Ashok Alva, Former Vice-President, Carborundam Universal Ltd., Chennai.

Dr.U.G.Bhat, Reader & Chairman, P.G.Department of Marine Biology, Karnatak University, Karwar

Calicut

Dr. V.S. Korikanthimath, Director, ICAR Research Complex, Goa.

Personnel
(Key Positions only)

Director	**Prof. (Dr.) Mohan Joseph Modayil**
Heads of Divisions	
Fishery Resources Assessment Division	Dr.M. Srinath
Pelagic Fisheries Division	Dr.N. Gopalakrishna Pillai
Demersal Fisheries Division	Dr.(Mrs.) S. Sivakami
Crustacean Fisheries Division	Dr.E.V. Radhakrishnan
Molluscan Fisheries Division	Dr.K.K. Appukuttan
Fishery Environment Management Division	Dr.M. Rajagopalan
Phisiology, Nutrition and Pathology Division	Dr.R. Paul Raj
Socio-Economic Evaluation & Technology Transfer Division	Dr.R. Sathiadhas
Marine Biodiversity Division	Dr. (Mrs.) Rani Mary George
Mariculture Division	Dr. G. Gopakumar
Sr. Administrative Officer	Shri K. L. Meena
Sr. Finance & Accounts Officer	Shri. G. P. Sharma
Administrative Officer	Shri N. Viswambharan
Scientists-in-Charge of Regional/Research Centres	
Mandapam Camp	Dr.N. Kaliaperumal, PS
Chennai	Dr.H. Mohamed Kasim, PS
Tuticorin	Dr.A.C.C. Victor, PS
Kakinada	Dr.R. Narayanakumar, Senior Scientist
Karwar	Dr.V.S. Kakati, PS
Mangalore	Dr.C. Muthiah, PS
Veraval	Dr.K.V. Somasekharan Nair, PS
Vizhinjam	Dr.A.P. Lipton, PS
Mumbai	Dr.V.D. Deshmukh, PS
Minicoy	Shri.K.P Said Koya, Scientist (SG)
Visakhapatnam	Dr.G. Syda Rao, PS
Calicut	Dr.P.N. Radhakrishnan Nair, PS
Krishi Vigyan Kendra	Dr.P.K. Martin Thomas, Technical Officer

Special Infrastructure Development

- A walk in marine aquarium with 20 number of glass aquaria have been set with all needed infrastructure at Headquarters, CMFRI, Kochi.
- A project site office and laboratory were set up at Port Blair, Andaman & Nicobar Islands for implementing the DOD funded scheme on black pearl production.
- Restoration of seawater pumping system destroyed by tsunami at Kovalam Field Laboratory by relaying the PVC pipes and repairing the electrical and diesel pumps.
- Action has been taken to reconstruct the infrastructure like the larval rearing lab, feed preparation lab, air compressor room and compound wall damaged by the tsunami at Kovalam Field Laboratory. Replacement of major and minor equipments damaged due to tsunami at Kovalam Field Lab was also carried out.
- More computer systems and other accessories have been procured to improve the data processing in the DPU at Chennai Research Centre, research out put by the Scientists and the efficiency of the administration.

Marine aquarium

Official Language Implementation 2004-2005

During the year the use of Hindi was ensured with the moto ***Hindi communication our mission*** and the programmes implemented in brief are as follows.

I. Implementation of Routine Official Language policy matters

- Bilingualisation:

  By the issue of check points at various capacities ensured the bilingual use of stationery items, mailing lists, computors, Section 3(3) documents, charts, maps etc.

- Hindi correspondence:

  The letters received in Hindi were replied in Hindi and in Hindi correspondence marginal increase was noted from 40.2 to 40.4%. Hindi notings increase was recorded from 21% to 30%.

- Official Language Implementation Committee meeting

  To monitor progress regular meetings of the Official Language Implementation Committee were conducted and the decisions ordinated.

- Inspections to watch the progress:

  The Drafting and Evidence committee of the Committee of Parliament on Official Language inspected the Calicut Research Centre of CMFRI on 28-12-2004 and recorded a satisfactory note. The Director, CMFRI inspected the Hindi activities of Mandapam, Tuticorin Centres of CMFRI. The three inspection committees inspected the various Sections/Divisions/Cells at Headquarters and gave suggestions for improvement.

- Progress reports and reviews:

  Through the quarterly reports, reviewed the progressive use at Headquarters and 12 Centres and gave suggestions for improvement. The progress of obligatory trainings monitored through half yearly reports and the annual reports on implementation.

- Incentives and special incentive schemes :

  In addition to the Government of India incentives Scheme, the CMFRI special incentive schemes introduced in 2002 have been revamped by making them more participative and popular.

A view of the Hindi workshop

Dr. E.V. Radhakrishnan, HOD, CFD and Dr. V. Chandrika, PS, FEMD receiving the Rajbhasha Rolling Trophy from Dr. Atmaram Srivasthav, Head, Department of Post Graduate Education, Dakshin Bharat Hindi Prachar Sabha, Cochin

Hindi week celebration

To enshrine the importance of Hindi as Official Language and to create to conducive atmosphere to work in Hindi, Hindi Week as observed with various competitions and workshops from 14 to 20 Sept., 2004. Inorder to highlight major contributions and to recognize/congratulate the contributors with awards/prizes valedictory function was conducted on 20th September, 2004. The Rajbhasha Rolling Trophy of the year for excellent activities was shared between CFD and FEMD.

कार्यकारी सारांश

केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान ने वर्ष 2004-2005 के अपने अनुसंधान में समुद्री मछली संपदाओं के टिकाऊपन के तहत 51 गृहांदर परियोजनाएं, 35 प्रायोजित राष्ट्रीय परियोजनाएं, एक प्रायोजित अन्तर्राष्ट्रीय परियोजना, 6 एन ए टी पी परियोजनाएं और 9 परामर्श परियोजनाएं कार्यान्वित कीं. वर्ष 2004 के दौरान समुद्री जैवविविधता प्रभाग और समुद्री संवर्धन प्रभाग नामक दो नए प्रभाग खोले गए. प्रमुख उपलब्धियाँ नीचे प्रस्तुत की जाती है.

प्रग्रहण मात्स्यिकी

भारत की समुद्री मछली पकड वर्ष 2004 में उपांतिक रूप 2.6 से दशलक्ष टन आकलित की थी जबकि उत्पादन में पिछले वर्ष की तुलना में 1 % की घटती दिखाई पडी. कारण, तारली, बंबिल, क्रोकर्स, सुरमई, फीतामीन, ट्यूना, पेनिअइड झींगा, नॉन - पोनिअइड झींगा और शीर्षपादों की पकड में हुई घटती है. समुद्री मछलियों का सब से अधिक अवतरण पश्चिम तट में हुआ जो 65% था. यंत्रीकृत सेक्टर से 68% मोटोरीकृत सेक्टर से 25% और कारीगरी सेक्टर से 7% मछली प्राप्त हुई थी. पकड पर *मारकोव चेन मॉडल* द्वारा चलाए अध्ययन ने सूचित की कि यदि पश्चिम तट में मछलियों का शोषण इसी तरह जारी रहें तो पकड में घटती आ जाएगी.

तारलियों की पकड में पिछले वर्ष की अपेक्षा 23,000 टन की घटती दिखाई पडी. पिछले 50 वर्षो में मिली वर्षा और तारली पकड के आधार पर बनाए ग्राफिक मॉडल से मात्स्यिकी का पूर्वानुमान किया जा सकेगा. यह देखनेलायक है कि अक्तूबर - दिसंबर के दौरान 60-105 मि मी के आकार के तारलियों ने पश्चजलों में प्रवेश किया था. प्राप्त तारलियों में बौने/नाटे दिखाए पडे. सूनामी के बाद इनके और समुद्री मात्स्यिकी के जैविक अभिलक्षणों में कोई विशेष व्यतियान नहीं दिखाया पडा.

महाराष्ट्र में परंपरागत डॉल नेट के ज़रिए एंचोवी मछली का जो पकड प्राप्त होती थी वर्ष के दौरान कम दिखाई पडी, बदले में ट्रालरों में इसकी अच्छी पकड मिली भी.

पश्चिम और पूर्वी तटों में सुरमइयों का अधिक शोषण अनुपात दिखाया पडा. इसे सुलझाने को छोटी जालाक्षिवाले *पोडिक्लै* के उपयोग रोकने, काँटा डोर को प्रोत्साहित करने और बडे जालाक्षिवाले गिल नेट मत्स्यन को गहरे सागरों में भी बढाने के सुझाव कार्यान्वयनाधीन है.

महाद्वीप में ट्यूना मछलियों की पकड में वर्ष 2003 की तुलना में 13% की कमी हुई जबकि मिनिकोय में पकड में वृद्धि हुई. *यूथिनस अफिनिस* मछलियों की पकड 17000 टन के निकट पहूँचकर स्थिर और इष्टतम दिखाया दिया. भारतीय बाँगडों की पकड में 26% वृद्धि हुई. बाँगडों की पकड में सूनामी का कोई असर नहीं देखा सिर्फ चेन्नै में जनवरी-फरवरी महीनों में मत्स्यन निलंबित रह गया.

रिपोर्टाधीन वर्ष में फीतामीनों की पकड में करीब 17,000 टन की कमी हुई. वेरावल को छोडकर बाकी सारे तटों में इसके अतिविदोहन की स्थिति को जाँचकर पकड श्रम में संयम बर्तने की चेतावनी दी, विशेषकर पूर्व तट में.

तलमज्जी मछली वर्ग में उपास्थिमीन कुल पकड का 9.1% था. इस में समाहित सुरा, रे, व शंकुश की पकड यथाक्रम 61%, 33 % व 6% थी. अपूर्व रूप से मलबार तट में 100 मी गहराई से महासागरीय सुरा *अलपियास वलपीनस* की पकड हुई. कालीकट में सुरा *हेमिप्रिस्टिस इलोंगेटस* की पकड हुई. ग्रूपर मछलियों की पकड में 7% वृद्धि होने पर शिंगटियों (काटफिश) की पकड में 400 टन की घटती हुई.

वर्ष 2003 की तुलना में थ्रेडफिन ब्रीम्स और सिलवर बेल्ली मछलियों की पकड में यथाक्रम 18% और 8% की बढती हुई. मलबार के तटों में झींगा *नेमिप्टीरस जापोनिकस* का अतिशोषण रिपोर्ट की. पूर्व एवं पश्चिम तीरों में *नेमिप्टीरस जापोनिकस* पर किए ट्रस मोर्फोमेट्रिक विश्लेषण ने व्यक्त किया कि इस जाति की जीवसंख्या और प्रभव में अंतर है. क्रोकर मछलियों का अखिल भारतीय अवतरण पिछले वर्ष के समान 1.21 लाख टन में स्थिर रहा . तुम्बिलों के जीवसंख्या प्राचलों पर किये गए अनुमानों ने व्यक्त किया कि इसका अतिविदोहन हो रहा है. कालीकट में चपटी मछली *साइनोग्लोसस माक्रोस्टोमस* का भारी विदोहन प्रत्यक्ष में आया था.

माँग्लूर में तट से दूर 10 और 50 मी गहराई वाले समुद्र में बोट्टम ट्रालिंग के प्रभाव पर किए अध्ययन ने व्यक्त किया कि नितलस्थ प्राणिजातों के आवास और वर्गविन्यास में जौवविविधता आ गई है.

क्रस्टेशिया अवतरण में 2004 के दौरान घटती दिखाई पडी. इसका अवतरण कुल वार्षिक अवतरण का 14.2% था. क्रस्टेशिया वर्ग में मुख्य पकड पेनिआइड झींगा (47.8%) और नॉन - पेनिअइड झींगा (31.7%) की थी. सौराष्ट्र क्षेत्र से झींगा जैसे *पी.स्टाइलिफेरा*, *एम.स्ट्रिडुलन्स,*

एम.कचेनसिस, *एम. बेविक्रोर्निस* और *पी. मेरगुएनसिस* की अच्छी पकड प्राप्त हुई थी. कालिकट में *एफ.इंडिकस* की उच्चतम वहनीय पकड पर किए प्रभव निर्धारण अध्ययन ने व्यक्त किया कि मत्स्यन प्रयास 1.6 बार बढाया जा सकता है. वर्ष 2003 की तुलना में गहरा सागर चिंगट पकड बढ गयी, पकड 2113 टन था. डॉल नेटों में *असेटस* झींगो की पकड कम होने की वजह से नॉन पेनिअइड पिछले वर्ष की तुलना में कम थे. चिंगटों की पकड में पिछले वर्ष की अपेक्षा करीब 193 टन के बराबर उपांतिक वृद्धि हुई. मुंबई तटों में *पानुलिरस पोलिफागस* का अतिविदोहन देखा गया जिसे तुरंत रोका जाना है. कालिकट, कोचीन और काकिनाडा की पकड में केकडा *चारिब्डस लूसिफेरा* की पकड हुई जो नई घटना है.

शीर्षपादों का अखिल भारतीय आकलित उत्पादन 1.13 लाख टन के बदले में उत्पादन में 4% की घटती दिखाई पडी. केरल में रातकालीन आनायन स्वयं रोकने की वजह से कुल उत्पादन और उत्पादन दर में वृद्धि आई है. वर्ष 2002 से *सेपिया फारोनिस* के Z वाल्यू में लगातार बढती जो दिखाई पडती है गंभीर से विचार करने का विषय है. वर्ष 2004 में अखिल भारतीय द्विकपाटी (bivalve) उत्पादन में 28% की घटती हुई. सूनामी के बाद पाक खाडी स्क्विड *एस.लेसोनियाना* और पवित्र प्रशंख *जांकस पाइरम* के अर्धजीवाश्म (सेमिफोसिल) का अवतरण बढ गया है.

समुद्री संवर्धन

मंडपम में डामसेल मछली *डासिल्लस ट्रिमाकुलाटस* का सफल प्रजनन साध्य हो गया. मान्नार खाडी में झींगा *पी. सेमिसुलकाटस* के 2.4 मिलियन पश्च डिंभकों का समुद्र रैंचन किया. प्रयोगशाला झींगा जाति पानिलुरस सेमिसुलकाटस का परिपक्वन और अंडजनन किया जा सका. पहली बार प्रग्रहण स्थिति में *पानुलिरस लोंगिपेस* के परिपक्वन और अंडजनन सफल निकले. स्लिप्पर लोबस्टर *थेनस ओरियेन्टालिस* के डिंभक पालन करने के खाद्य और खाद्य क्रम का मानकीकरण किया. वयस्क मादा शूली चिंगटों में किए एकपार्श्वीय नेत्रवृंत अपरदन ने सूचित किया कि इस से यद्यपि बढत दर में कमी होती है तथापि पुनरुत्पादन सक्रियता और तद्वारा बारंबार अंडजनन साध्य हो जाता है. समुद्री उत्पाद निर्यात विकास प्राधिकरण द्वारा प्रायोजित परियोजना के अधीन महाचिंगटों की परिरक्षा और अंडधारी महाचिंगटों की सुरक्षा संबंधी प्राथमिक अभियान तमिलनाडु में कार्यान्वित किया गया.

आम तौर पर शंबुओं का पालन रस्सियों में किया जाता है; उन से शंबुओं को आसानी से उतारने केलिए संस्थान ने एक यांत्रिक उपकरण का निर्माण किया. शंबु पालन में शंबुओं को बोने की विशेष रीति होती है कासरगेड और कालीकट में जहाँ इसकी अच्छी पालन साध्यता है वहाँ किसानों के बीच इस रीति का प्रचार किया जा रहा है. रस्सियों के बदले में खंभों में पालने की रीति है बैचूट (bouchot); इस रीति में तीन महीनों के अंदर एक मी की लंबाई के खंभे से 12 कि ग्राम शंबु प्राप्त किया जा सका. खाद्य शुक्ति का पालन उनके स्पाटों की बुआई किसी संस्तर विशेषकर घोंघो (सीपिकवच) के टुकडों में बुआई अब साध्य हो गई है. समुद्री मोतियों के ऊतक संवर्धन प्रणाली में किए पात्रे पालन में बीड को चमक प्रदान करने वाली वस्तु यानी नेकर बन जाने की प्रक्रिया कई महीनों तक जारी रहते हुए देखा. धातुओं से पोषण करने पर मोतियों का रंग बढते हुए देखा, इससे चमक में कोई अंतर नहीं दिखाया पड़ा. राष्ट्रीय कृषि प्रौद्योगिकी परियोजना के अधीन भारत में शंबु बीज संपदाओं की उपलब्धि और पालन अनुयोग्य स्थानों का जियोग्रफिकल इन्फर्मेशन सिस्टम (जी आइ एस) छायांकन पूरा किया गया. आन्डमान निकोबार द्वीप समूहों में काली चोंच सीपी *पिंक्टाडा मारगरिटिफेरा* के पालन और अंडशावक (ब्रूडस्टॉक) विकास संबंधी अध्ययन शुरू किया गया.

कारागीनन प्रदान करनेवाला लाल समुद्री शैवाल *काप्पाफैकस अलवरेज़ि* का परीक्षणात्मक पालन में पाया गया कि कोचीन में 40 दिवसों की पालन अवधि में प्रति दिन 16 ग्रा की बढती होती है जबकि मंडपम में 22-34 दिवस में इस से 4-5 गुनी और कालीकट में 60 दिवस में 4 गुनी बढती होती है.

पर्यावरणीय और जैवविविधता अध्ययन

संस्थान ने केरल के समुद्र तीरों में उगनेवाले विषालु/हानिकारक पादपप्लवकों का अध्ययन अगस्त-सितंबर के दौरान किया. ऐसे फुल्लन (ब्लूमिंग) होनेवाले समुद्रों की मछलियाँ खाने से होनेवाले दोष भी लोगों को समझाया. वेरावल, मुंबई, कोचीन, चेन्नै और कारवार जहाँ औद्योगिक बहिस्राव से पानी मलिन हो जाने की रिपोर्ट है, की सच्ची स्थिति समझने केलिए किए गए अध्ययन ने व्यक्त किया कि पानी काड्मियम, लेड, कॉपर और निकल जैसे धातुओं से दूषित है. समुद्रकृषि केलिए अनुयोज्य स्थान पहचानने को जियोग्रफिकल इन्फर्मेशन सिस्टम द्वारा चलाए अध्ययन ने कार्नटक में तीन और आंध्रप्रदेश में दो स्थान अनुयोग्य सूचित किया. भारतीय अनन्य आर्थिक मेखला में *एफ ओ आर वी सागर संपदा* द्वारा संग्रहण किए नमूनों से लूसिफेरा कुटुम्ब के प्लवकी झींगों के वर्गिकी मोनोग्राफ़ तैयार किया.

महासागर विकास विभाग द्वारा प्रायोजित एक परीयोजना में *एफ ओ आर वी सागर संपदा* द्वारा किए 10 पर्यटनों में अरेबियन समुद्र और बंगाल की खाडी में दृष्टिगत हुए 146 समुद्री सस्तनियों का उल्लेख किया. सीटेशिया की ऊतकों में 23 मूलकों पर किए प्रदूषण अध्ययन से स्पष्ट हुआ कि एक ही जीव के भिन्न माट्रिसों (matrice) में परिवर्तन है. मोलिकूलार टैक्सोनमी में उपयोगी माइटोकोन्ड्रियल डी एन ए टैंपिंग में, *टरसियोप* जाति, *स्टेनेल्ला लोंगिरोस्ट्रिस, ग्रांपस ग्रिसियेस, डोल्फिनस डेल्फिनस* और *फैसेटर माक्रोसेफालस* में प्राइमर स्पेसिफिक बेंड स्पष्ट हुए.

जैवप्रौद्योगिकी

फैटेस का उत्पादन करनेवाले बासिल्लस स्टैन का पहचान किया और इसे IJ – Bacillus lichen informis-MTCC 6824 नाम से अभिहित किया. किण्वित उत्पाद से बासिल्लस का उपयोग करते हुए फैटेस एनाज़ाइम के शुद्धीकरण करने की प्रक्रिया का मानकीकरण किया.

समुद्री पादप *अल्वा फासियेटा* से विकिसत किए 23 सोलवेंट फ्राक्शनों ने कई रोगकारी जीवाणुओं के खिलाफ़ लडने की शक्ति दिखाई. चिंगट से विघटन किए बाक्टीरिया से एक अनुमानित प्रोबयोटिक बाक्टीरियल स्ट्रेन G 23 (बासिल्लस जाति) का विघटन किया. इसका परीक्षण चिंगट *एफ. इंडिकस* में किये जाने पर रोग प्रतिरोध और प्रतिरक्षा करने के लक्षण दिखाए पडे.

तारली और *नेमिप्टीरस जापोनिकस* मछलियों पर किए आनुवंशिक फिंगर प्रिंटिंग ने स्पष्ट किया कि तारली की जीवसंख्या और *एन. जापोनिकस* के प्रभव में पूर्व और पश्चिम तटों में बदलाव पड गया है.

समुद्री अलंकार मछली *अबुडेफड़फ* की चार जातियों के जातिवंशीय संबंध का अध्ययन किया गया. पालतूकरण किए क्लाऊन मछली *अम्फिप्रिओन सेबे* का माइक्रोसाटलैट डी एन ए सीक्वेन्स का विकास किया जिसका पंजीकरण सं. DQ079821 में करके जेन बैंक (NCBI) ने विमोचन किया.

विस्तार और आर्थिकी

समुद्री मछली अवतरण के मूल्य स्वरूप विश्लेषण ने व्यक्त किया कि वर्षारंभ बिक्री और अवसान बिक्री की तुलना में सिर्फ क्रस्टेशियनों में 40% सकल राजस्व प्राप्त हुआ था. वर्ष के दौरान यंत्रीकृत सेक्टर में निक्षेप कम हुआ था. संस्थान ग्राम संपर्क परियोजना के अंदर 6 मध्यवर्ती कार्यक्रम केरल के एक चुने गए गाँव में उद्यमियों के खेतों में कार्यान्वित किए गए. ग्रे मल्लेट और मिल्क फिश का एकल पालन, बहुविध पख मछलियों का पालन, पशु धन पालन, मुर्गी पालन और नारियल खेती के इन मध्यवर्ती प्रयोगों में किसानों ने 25% अतिरिक्त आमदनी प्राप्त की.

संस्थान के कृषि प्रौद्योगिकी सूचना केंद्र ने वर्ष 2004 के दौरान रोगनिदान सेवाएं, प्रयोगशाला परीक्षण, मूल्यवर्द्धित उत्पादों, प्रकाशनों और अन्य प्रौद्योगिकी पुर्जों की बिक्री से 1.8 लाख रु कमाए. *समुद्री प्रदूषण, समुद्री शैवाल से पकवान* और *समुद्री अलंकारी मछलियाँ* विषय पर 3 विस्तार पत्रिकाएं अंग्रेज़ी, हिंदी और मलयालम में प्रकशित की.

प्रकाशन, नई परियोजनाएं और मान्यताएं

संस्थान के कार्मिकों ने 9 विदेशी पत्रिकाओं को जोडकर अभिजात पत्रिकाओं में 48 वैज्ञानिक लेख, 71 तकनीकी लेख और संगोष्ठी/संवादों में 23 लेख प्रस्तुत किए. हिंदी किताबों की खरीद संबंधी आदेशों का कार्यान्वयन करते हुए सब से अधिक हिंदी किताबें खरीदने केलिए कोचीन नगर राजभाषा कार्यान्वयन समिति ने संस्थान को प्रशस्ति पत्र प्रदान किया. हिंदी में दक्षता बढाने के कई कार्यक्रम वर्ष के दौरान आयोजित किया. परिषद की तदर्थ परियोजना और महासागर विकास विभाग के निधीयन से सूनामी से जुडे मसले, मात्स्यिकी संपदा निर्धारण, लवण सह्य जीन, चिंगटों का अंडशावक विकास, रोगप्रतिरक्षा-निदान संबंधी अध्ययन, पोषण आदि संबंधी 13 नई परियोजनाएं पारित की गई.

प्रशिक्षण एवं शिक्षा

वर्ष 2004 के दौरान संस्थान के 11 नियमित छात्रों और अध्येताओं को पी एच. डी उपाधि प्रदान की गई. कृषि विज्ञान केंद्र ने 40 प्रशिक्षण कार्यक्रम और 106 पाठ्यक्रम आयोजित किए.

कमाया राजस्व

लक्षित आय 75 लाख रु के मद्दे संस्थान ने 83.4 लाख रुपए कमाए. इस उपलब्धि केलिए महानिदेशक, भा कृ अनु प ने संस्थान को सराहना पत्र प्रदान किया.

Acronyms Used

ADAK	Association for Development of Aquaculture in Kerala
ATIC	Agricultural Technology Information Centre
BFFDA	Brackishwater Fish Farmers Development Agency
CARI	Central Agricultural Research Institute
CGP	Competitive Grants Programme
CIBA	Central Institute of Brackishwater Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoF	College of Fisheries, Mangalore
DBT	Department of Bio-Technology
DOD	Department of Ocean Development
DST	Department of Science & Technology
E	Exploitation Rate
FAO	Food and Agricultural Organisation
FSI	Fishery Survey of India
GAU	Gujarat Agricultural University
GOPL	GMR PSEG Operations Private Limited, Mangalore
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
IFS	International Foundation of Science
IGIDR	Indira Gandhi Institute of Development Research
IOTC	Indian Ocean Tuna Commission
ISD	Information System Development
IVLP	Institution Village Linkage Programme
KIOCL	Kudremukh Iron Ore Company Limited
KKV	Konkan Krishi Vidhyapeeth
MM	Mission Mode
MOE&F / MEF	Ministry of Environment & Forest
MPEDA	Marine Products Export Development Authority
MRPL	Mangalore Refineries and Petrochemicals Limited
MSY	Maximum Sustainable Yield
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agricultural and Rural Development
NATP	National Agricultural Technology Project
NBFGR	National Bureau of Fish Genetic Resources
NGOs	Non-Governmental Organisations
NIO	National Institute of Oceanography
PSR	Production Systems Research
RC	Research Centre
RGCA	Rajiv Gandhi Centre for Aquaculture
SEAFDEC	South East Asian Fisheries Development Centre
SFDs	State Fisheries Departments
TANUVAS	Tamil Nadu Veterinary and Animal Science University
WFC	World Fish Centre
Z	Mortality Rate

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